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AGROSTAN

A Case Study for the 1970 World Census of Agriculture

UNIT IV. ENUMERATION PLAN AND SAMPLE DESIGN

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AGROSTAN: A Case Study for the
1970 World Census of Agriculture

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Chapter IV - 1. DECISIONS AFFECTING DESIGN OF THE CENSUS

1. *INTRODUCTION*

As part of the initial planning for Agrostan's Census of Agriculture, basic data needs of the country were determined in conversation with major users of agricultural statistics. From this information, key decisions were made (see Unit II of the case study) on such important questions as:

> What statistics should be collected in the census, for what level of publication, and with what reliability?
>
> Should the data be collected by a complete census or a sample census?
>
> What should be the general approach in designing the sample, once the decision is made to take a sample rather than a complete census?

This chapter (chapter IV-1) outlines the considerations involved in making the decision to take a particular type of sample census of agriculture and gives some basic principles that should be followed in designing and selecting the sample. Later chapters provide a more detailed discussion of the sample design and estimation procedures.

2. *TYPES AND RELIABILITY OF STATISTICS REQUIRED*

2.1 Types of statistics required

The needs for and uses of agricultural statistics were discussed earlier in the case study (see chapter 1 of Unit I). It is apparent that different users require many different types of statistics, and that there is no single most important item to be obtained in an agriculture census. Furthermore, the statistics may concern different segments of the population. Tenure of holding, size of holding, land utilization, size of household, and income of the holder's family are typical items of important information that apply to every holding in Agrostan. Just as important to the economic development plans of Agrostan are many characteristics which can be associated with only a subgroup of the holdings in the country. For example, only the larger holdings may report use of mechanical power, production of particular types of livestock or crops, and use of chemical fertilizer. Therefore, the census must be designed so that data on a great variety of characteristics, distributed differently among the agricultural holdings, can be collected at an acceptable level of reliability. The table outlines in Unit III illustrate the different types of data which will be required from the Agriculture Census of Agrostan.

2.2 Level of publication

The administrators, economic planners, and other users of agricultural statistics also dictate the level of publication for the census. If the data requirements of the country are confined to the National level, then the amount of effort required to collect, process, tabulate, and publish statistics for the nation as a whole will be considerably less than that required to produce separate statistics for districts or Provinces. The effect of the level of publication on the required size of sample is particularly important. In the case of Agrostan, it was determined that more detailed cross-classifications are needed at the Province and National levels than at the district level (or zone level in the Northern Territory). The census must be designed, therefore, so that important data can be published at the district (or zone) level in the form of simple distributions of characteristics and more detailed distributions and cross-classifications can be published at the Province and National levels.[1]

---

[1] Data will not be published separately for very small districts; these will be combined, and figures published for the combined area.

2.3 Level of reliability

Another initial decision affecting sample size and design concerns the minimum level of reliability that can be tolerated for the majority of characteristics on which data are to be collected in the census. The major users of the data should help to make this determination. For example, if a planning economist indicates that he would make the same decision even though a statistic were 10% higher or lower than reported, then, for his purposes, it is not necessary to incur the expense of planning a census with errors smaller than 10%. Most users of statistics do not think about data in terms of minimum level of sampling error, however, and the statisticians usually must take the initiative in this decision.

The errors in estimates from a multi-purpose sample survey will differ for different characteristics, depending on the variability of the characteristics, or--in the case of attributes--depending on the proportion of units having the attribute. An item which does not vary much among different holdings, or an attribute possessed by a large proportion of all holdings, can be estimated with greater accuracy than other items. The desired reliability must, therefore, be set either for a very important class of items, or a typical item, with the understanding that the accuracy of other items will vary according to their relationships to the basic items. These expected variations must also be checked for acceptability.

Districts in the Provinces and zones in the Northern Territory are the smallest administrative divisions for which separate estimates will be published from the sample census of agriculture, and data users will expect a reasonable level of accuracy for such estimates. However, the districts making up the 13 Provinces vary in size from less than 5,000 to over 100,000 rural population (according to the 1960 Census of Population), and the three zones of the Northern Territory vary from an estimated 74,000 to 106,000 rural population (exhibit I-2-17). If the same sample plan is used in all districts and zones, therefore, the larger administrative divisions will have larger samples and more accurate estimates than the smaller ones. In order to have a uniform sampling plan and a relatively easy method of analyzing results, it was decided after considering several alternatives, to establish a desired level of accuracy for the average district (or combination of small districts). In the Northern Territory, a somewhat different minimum level of desired accuracy was set for the zone estimates, with the condition that it should apply to all three zones, as explained below.

2.31 Provinces.--In the Provinces, the standard of reliability for district estimates in an average-size district was set at 5% coefficient of variation for estimates of characteristics associated with half of all holdings, and correspondingly larger errors would be allowed for smaller-than-average districts, and/or for characteristics associated with less than half the holdings.[2] Characteristics associated with more than half of all holdings are expected to have smaller errors; for example, an estimate of a characteristic associated with all holdings, such as their average size or the total land in all holdings, might have a coefficient of variation of about 2.5% in an average-size district. Some very small districts, which would have very large errors, are to be combined for publication purposes (see chapter 2).

At the Province level, the errors discussed above might be reduced from 5% and 2.5% to about 2% and 1%, respectively.[3] Estimates for subgroups, such as tenure classes, would have somewhat larger, but acceptable, errors at the Province level. Errors for estimates of the same characteristics for the 13 Provinces as a whole would be about a third as large as those for individual Provinces.

2.32 Northern Territory.--In the Northern Territory, each of the zones is larger than an average district in the Provinces. With only three zones, even the smallest of them is sufficiently important to have a specified accuracy, rather than setting a desired level for the average zone. The limit of error for the smallest zone was set at a slightly higher level (lower accuracy) than the standard required for the average district. The detail requirements (estimates for subgroups) were also much more limited for the Northern Territory. It was agreed that sampling errors for the smallest zone may be as large as 5% or 10% without leading to wrong decisions by data users. The larger zones will then have smaller errors. Because of differences in data requirements and field conditions, and expected difficulties in data collection, the sample design for the Northern Territory is different from that for the Provinces. It also illustrates another application of the principles of sampling adapted to these differences and difficulties. The sample design and data-collection plans for the Northern Territory are, therefore, discussed separately--see chapter 5 of Unit IV of the case study.

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[2] The coefficient of variation (relative standard error) is the standard error divided by the estimate and is expressed as a percentage. In order to obtain a 95% confidence level, use two times the coefficient of variation.

[3] The number of districts in a Province ranges from 8 to 20; thus. the Province samples are many times larger than the district samples.

3. *SAMPLE OR COMPLETE CENSUS*

The decision on the types of data required and the publication level and reliability level is closely related to the decision on whether to take a complete census (enumerate every holding) or a sample census (enumerate a sample of holdings), or possibly a combination of the two.

3.1 *Advantages of a complete census*

Some of the advantages of taking a complete census are listed below. Each implies a corresponding disadvantage of taking a sample census.

(1) There is no sampling error in a complete census. (Nonsampling errors, however, are inherent in a complete census as well as in a sample census; refer to section 3.4.)

(2) Data can be produced for relatively small administrative areas.

(3) The data may be more readily accepted by some users.

(4) Since preparation of a sampling frame (list of holdings) and selection of sample holdings would not be required, the field procedures and the procedures for analysis of the tabulated results are generally less complex than those required for a sample census.

3.2 *Advantages of a sample census*

On the other hand, there are many advantages in taking a sample census. Some of the more important advantages include the following:

(1) In most situations, the costs of a sample agriculture census in terms of money, materials, and personnel are considerably less than those of a complete census.

(2) The data can be made available to the users at a much earlier date than is possible in a complete census. In many countries, collecting the information and processing a large number of questionnaires (approximately 1,000,000 for Agrostan) provides a serious obstacle to early publication of the census results. In comparison, the processing and tabulation of questionnaires for a sample (around 75,000 for Agrostan) can be completed before the results become out-of-date.

(3) A sample census requires fewer trained persons as enumerators and supervisors. At a rate of 80 to 100 interviews per enumerator, a sample census of Agrostan would require only 800 to 900 enumerators and supervisors. A complete census in Agrostan, at a rate of 200 interviews per enumerator (allowing for less travel), would require at least 5,000 enumerators and supervisors. To accomplish such a large task, it may be necessary to disrupt other government activities to provide the required personnel and other resources; indeed, the task may be impossible.

(4) It is possible to select the smaller group of sample census enumerators more carefully and to train them more intensively, with the expected result that nonsampling errors will be smaller in a sample census than in a complete census.

3.3 *Decision to take a sample census*

Every one of the advantages of taking a sample census applies to Agrostan's situation. At the same time, all of the advantages of taking a complete census apply to some extent. The Working Group and the sampling technicians of the National Statistical Office (NSO), after determining the type and reliability of data that were required and considering the advantages and disadvantages of a complete census as compared with a sample census, reached the decision that the census data could be most efficiently collected through the following plan:

(1) A complete enumeration of all the very large holdings and those with specialized agricultural operations.

(2) A sample of the small and the medium-size holdings.

This decision took into consideration that (a) funds to carry out a complete enumeration of holdings would likely not be available, (b) the advantages of a sample census (lower cost, improved quality, etc.) seemed much greater than the advantages of a complete census, (c) the disadvantages of taking a sample census (in terms of sampling error, added complexities associated with sample selection and processing) could be controlled, and (d) the most important agricultural operations in the country, accounting for a very large part of the total agricultural production, could be identified and included in the census with certainty, at very little cost. The decision also took account of the need to provide a frame for conducting intercensal surveys.

3.4 *Effects of nonsampling errors*

Errors associated with the results of a sample census are of two general types: (a) sampling error, which results from enumerating a sample rather than the complete population, and (b) nonsampling errors, which result from inaccurate responses; incompleteness of field work; errors in editing, coding, and processing; and other errors or failures not related to sampling.

Any response problem which arises in a complete census will most likely occur also in a sample census. A sample census cannot be expected to eliminate response errors, but will reduce the number of problem cases which must be examined, and thus may require the expenditure of a smaller amount of total effort. Furthermore, the use of a sample will permit a more thorough investigation of each problem case; thus nonsampling errors can be better controlled in a sample census.

There is reason to believe that response errors are particularly important in agriculture censuses. For Agrostan, it was decided to place emphasis on controlling nonsampling errors through great care in selecting enumerators and supervisors and through an intensive training program.

4. *BASIC PRINCIPLES IN SAMPLE DESIGN*

A number of basic principles were kept in mind in designing the sample census for Agrostan. These principles may be summarized as follows:

(1) Before undertaking any census (either a complete or a sample census), one must decide what data are to be collected and the population from which they are to be obtained. One must define the "universe."

(2) By some means, a "frame" must be established from which a sample can be selected. The frame may be made up of several parts; for example, a basic frame of ordinary holdings and a supplemental frame of holdings with specialized agricultural operations. In total, the frame should cover the whole "population" being studied.

(3) Every holding in the population should have a chance of being selected in the sample; and this chance of being selected should be known.

(4) The sample design should be as simple and straightforward as possible so that it can be carried out as planned.

(5) It must also be possible to carry out the sampling plan within the time limits and financial limits which have been established administratively; if the plan fails in these respects, the results may not be available at the time when they are needed, or indeed the census may never be finished. Data may be collected, but there may be no money for tabulation, or for analysis of the results.

(6) Unbiased procedures should be used in planning and carrying out the census.

(7) It should be possible to estimate the reliability of the estimates from the sample data themselves.

(8) In choosing from the alternative sample proposals which would lead to a suitable sample design, one should use a method which yields the maximum amount of information for the amount of money expended.

(9) By means of adequate supervision and control, one must actually carry out the survey in accordance with the specifications which have been prescribed.

Principles 6, 7, and 8 lead to the selection of a probability sample.

Chapter IV - 2. SAMPLE DESIGN AND ENUMERATION PLAN FOR THE PROVINCES

This chapter describes the sample design and enumeration plan for the 13 Provinces, which contain about 95% of the total population of Agrostan. Methods of selecting the sample units are discussed in greater detail in chapters 3 and 4. Plans for the Northern Territory, which make up the remainder of the country, are described in chapter 5.

1. *USE OF RESOURCES AVAILABLE FROM PREVIOUS CENSUSES*

In designing the sample for the 1971 Sample Census of Agriculture, the sampling technician will make use of the experience gained in the 1961 Sample Census of Agriculture. Materials from the 1970 Population Census also will be used. One of the first steps in planning the sample will be to collect available data and resources for use in the development of an efficient sampling plan.

1.1 Description of the 1961 Sample Census of Agriculture

The 1961 Sample Census of Agriculture was the first agricultural census taken in Agrostan. Because of a shortage of funds and of persons experienced in agricultural data collection, it was limited in scope and objectives. The Northern Territory was excluded entirely, and the census in the Provinces was a sample rather than a complete enumeration. During the enumeration, it was discovered that the Census program had been underbudgeted and inadequately planned, so that the quality of some of the information did not meet the expectations of the planners. In fact, results for several items were not published because it was believed that the concepts had not been interpreted correctly. Nevertheless, the remaining data gave rough estimates of production and inventory figures for a number of important agricultural items, and the experience gained will be useful in planning the second census of agriculture.

1.11 Level of publication and reliability.--Data were collected on the agricultural structure in each of the 13 Provinces of Agrostan for the purpose of planning for economic development. The Census obtained basic data on tenure, kinds of crops grown, area of crops harvested, production for six of the more important crops, land utilization, livestock numbers, expenditures, and indebtedness. Cross-tabulations of the data were made for a few characteristics. National estimates were prepared in slightly greater detail than estimates for individual Provinces.

No reliability specifications were set before conducting the census. Estimates were published for the nation as a whole (excluding the Northern Territory) and for individual Provinces, but not for the districts.

1.12 Sample design.--There were no trained sampling technicians in the National Statistical Office for the 1961 Census. The decision to conduct interviews for a sample of holdings was based primarily on the fact that the available funds for the agriculture census were insufficient for a complete enumeration. The sample design was very simple. Every 20th rural enumeration area (EA)[1] from the 1960 Population Census was selected for the sample--a total of approximately 550 EA's. All holdings within the sample EA's were enumerated for the Agriculture Questionnaire. This basic sample was supplemented with approximately 3,500 large holdings (having 500 hectares or more), which were included in the sample with certainty. The total sample size was over 40,000 holdings (an average of 70 to 75 holdings per EA).

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[1] In Agrostan, an enumeration area is an administrative area for purposes of taking the population census. In urban areas, one EA was assigned to several enumerators so that the census could be completed in 1 or 2 days; in rural areas, an EA was assigned to one enumerator to complete in 1 or 2 weeks. Any problem in the definition of EA's for the 1960 Population Census was a potential problem for the 1961 Census of Agriculture.

1.13 Enumeration plan.--The 1961 enumeration relied largely on the Ministry of Agriculture personnel. In most cases, sample EA's were assigned to the Agricultural Agent in whose area they were located. After a brief training, the agent was instructed to visit his sample EA (or EA's) and conduct interviews at every holding. Upon completion, the questionnaires were delivered to the Province Office of the Ministry of Agriculture and later transmitted to the National Statistical Office. There was very little checking of the enumerator's work in the field.

1.2 *Use of the 1961 agricultural data*

One of the published tables from the 1961 Census shows the number of holdings in various size categories (see exhibit I-2-21, which is included as a reference exhibit in Unit IV). This distribution of holdings by size will be useful in determining how much of the sample for the 1971 Census should consist of large holdings. It will also help in defining "large holdings" for the purpose of the 1971 Agriculture Census.

In addition to providing data for guiding the sample selection, results of the 1961 Census experience led to the following judgments concerning the 1971 Census:

(1) Objectives should be more clearly defined.

(2) District level data will determine the reliability required of the sample. Data for Provinces will then be sufficiently accurate.

(3) A subsample of holdings within the sample EA's should be used to obtain a more efficient sample than could be obtained by complete enumeration of all holdings in the EA.

(4) The census enumeration should be carried out by persons hired for the census and directly responsible to the NSO, rather than by persons primarily responsible for non-census activities.

1.3 *Use of the 1970 Population Census*

The chief source for selecting the sample for the 1971 Agriculture Census will be the preliminary population counts and the maps from the 1970 Census of Population, which will precede the 1971 Sample Census of Agriculture.[2] The 1970 Population Census EA's, with some modifications, will provide an up-to-date sampling frame of small census divisions covering the entire area of the Provinces.

Through the improved mapping program (discussed in Unit II of the case study), maps from the 1970 Population Census will be available for the agriculture census; it is expected that a number of these maps will have been brought up to date during the population census. The Geography Division staff will inspect the population census maps for the EA's that fall in the agriculture census sample, add whatever identification is needed, and generally improve the quality of the maps when it is feasible to do so. In some instances, new maps will need to be prepared to replace inadequate and lost maps.

It is hoped that some of the field supervisors and enumerators in the 1970 Population Census will also be available for the agriculture census. Thus, the timing of the 1971 Agriculture Census makes possible the efficient use of some important resources which will be reflected in the sample design and enumeration plan.

1.4 *Preliminary 1970 data*

Since final population counts will not be available in time to plan and select the sample for the agriculture census, preliminary counts will be sufficiently accurate for planning and sample selection. The preliminary counts of EA's will be transcribed to a worksheet, which can be conveniently used for planning the sample design. The sampling technician for the 1971 Agriculture Census should work closely with the staff in the Population Division of the NSO to insure that the necessary counts will be compiled and will be available. Exhibit IV-2-1 gives preliminary 1970 population counts by EA's for Ranchi District in Rajpur Province. Exhibits IV-2-2 to IV-2-5 give district summaries of urban and rural EA's for Rajpur, and Province summaries for all Provinces.

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[2] The 1970 Census of Population will be taken as of 1 May 1970; the 1971 Sample Census of Agriculture will be conducted in November-December 1971 in the Northern Territory and in January-February 1972 in the 13 Provinces.

Additional preliminary data useful for the overall planning of the sample census of agriculture are given in table 2A; they provide a rough idea about the country. (Text tables carry the chapter number followed by a letter.)

Table 2A. PRELIMINARY DATA FOR PROVINCES: 1970

Item	Number
Population, total Provinces........	9,374,552
Rural...........................	6,090,387
Percent of total..............	65.0
Number of EA's, total Provinces....	14,936
Rural...........................	11,826
Percent of total..............	79.2
Average population per rural EA....	515
Average number of housing units per rural EA (estimated)..........	95
Average number of holdings of 1/10 hectare or more per rural EA (estimated).......................	85
Approximate number of districts (or groups of districts) for which separate estimates are to be made*........................	150
Average number of rural EA's per district having separate estimates...........................	79

*This number was decided after inspection of the 1970 Population Census results.

2. OUTLINE OF THE 1971 SAMPLE DESIGN

In this section, it is assumed that several alternative sample designs satisfying the basic principles of chapter 1 (section 4) have been considered and a choice has been made. The design agreed upon for the sample in the Provinces is described in the remainder of this chapter (chapter 2). Chapters 3 and 4 describe the office and field operations required to select the sample in the Provinces. Chapter 5 discusses the sample design and selection in the Northern Territory.

The 1971 sample design for Agrostan can be described generally as a two-stage probability sample, although some holdings are selected in a single stage. Basically, the design involves selecting a sample of primary sampling units (PSU's) from which a subsample of holdings will be selected. A number of features have been introduced in the design, however, to increase its efficiency.

2.1 *Definition of the universe*

The universe or population of units about which agricultural information will be obtained consists of all agricultural holdings with two exceptions:

(1) Holdings of less than 1/10 hectare will be excluded unless they are so important as to be on the list of "National Certainty holdings" described below. A count of holdings of less than 1/10 hectare will be obtained, however.

(2) Holdings located in the built-up parts of cities of over 5,000 persons will be excluded unless they are on the list of "National Certainty holdings." (There is a possibility that a holding located in the built-up part of a city will have an operator who lives outside that part of the city. Such operators and their holdings are included.)

These exceptions in the universe definition will greatly reduce the cost of obtaining the information, while having only a very slight effect on the estimates that will be prepared. It is believed that the excluded holdings account for less than 2% of the total agricultural production of Agrostan in 1971.

2.2 *Reliability required*

Separate estimates are required for each of 150 districts or combined groups of districts making up the 13 Provinces.[3] Estimates for the average-size district should have a coefficient of variation of about 5% for characteristics associated with half the holdings and a coefficient of variation of about 2.5% for characteristics associated with all the holdings.[4] Larger sampling errors will be acceptable for small districts and for characteristics associated with less than half the holdings.

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[3] The 172 districts in the Provinces were reduced to 150 by combining the very small ones (those with an estimated total number of holdings under 2,500) to get areas suitable for making separate estimates.

[4] The coefficient of variation of an estimate is defined as the standard error of the estimate divided by the estimate. Thus, two times the coefficient variation will give the relative error at the 95% confidence level.

As stated in chapter 1 (section 2.3), Province and National estimates will have smaller errors, well within an acceptable range, if district estimates meet the specified standards. Hence the requirements at the district level are the deciding factor in the sample design.

2.3 Total sample size and workloads

The sample for a district of average size will include about 400 small holdings selected in about 20 primary sampling units and about 50 medium-size holdings selected with certainty from the same sample PSU's. It will also include all the large and/or commercially important holdings from the national list of such holdings (about 25 in the average district). Thus the sample for an average-size district will consist of about 475 holdings. Approximately 72,000 holdings will be in the sample for all districts.

Estimates of the sample size by Provinces and districts are needed for purposes of establishing a field organization and processing operations far in advance of the actual sample selection. These estimates would be prepared by the sampling technician as soon as the sample design is determined. Exhibit IV-2-6 gives the estimated workload for each of the Provinces, and exhibit IV-2-7 gives the workload, by district, for Rajpur Province. The term "workload" includes both the number of listings (housing units) and the number of interviews for the agriculture questionnaire. Note that the workload varies considerably from district to district and Province to Province.

2.4 Sample units, sampling rates, and methods of selection

The designation of the unit of sampling, the sampling rates, and the method of selection are necessarily closely related. Consideration must be given to a final plan which is practical and possible to carry out with accuracy.

2.41 National Certainty holdings.--Holdings on the national list of large holdings to be included in the sample with certainty, regardless of where they are located, are called National Certainty holdings. They include about 3,600 known estates, plantations, and other large holdings of 500 hectares or more. They include also some small holdings known to have specialized agricultural operations of great commercial importance to the agricultural production of the country. All holdings on the list of National Certainty holdings are enumerated, whether or not they are located in the selected PSU's described below.

2.42 The first-stage unit (PSU).--The remaining sample holdings will be selected in two stages. For this purpose, primary sampling units (PSU's) will consist mostly of 1970 Population Census EA's. Where the census EA's are considered to be too small or too large, they will be combined or subdivided before selection to form PSU's of more nearly equal size. The PSU's will be stratified (ordered) by whether they are urban or rural, by location within the districts, and possibly by other factors such as elevation and type of agricultural activity, if this information can be obtained from local sources.

Sample PSU's will then be selected systematically at the rate of 1 in 4, resulting in a total of about 3,000 sample PSU's for all districts. This will be an average of about 20 for each district requiring separate estimates.

2.43 Local Certainty holdings.--All holdings of more than a specified size which are located in the sample PSU's will be included in the sample with certainty and will be referred to as Local Certainty holdings. The size limits for these holdings will vary by Province--50 hectares, 100 hectares, or 200 hectares. Approximately 7,000 Local Certainty holdings are expected to fall in the national sample, but this number might vary by district from zero to 100 or more.

2.44 The second-stage unit (small holding).--A sample of 1 in 4 of all holdings between 1/10 hectare and the local certainty size limit will be selected. This will result in about 20 such holdings per sample PSU and about 400 for an average-size district. By definition, all holdings with less than 1/10 hectare are excluded from the universe, but the number of these small holdings will be available from the Listing Book.

2.5 *Weights*

Three weights will be required in tabulating the data. National Certainty holdings will receive a weight of 1, Local Certainty holdings will receive a weight of 4, and all other sample holdings will receive a weight of 16. These weights are the reciprocals of the probabilities of selection of the holdings.

3. *OUTLINE OF THE ENUMERATION PLAN*

It is planned that the listing and enumeration should be completed in about 6 to 8 weeks. Normally, one supervisor will be assigned to each district, and he will be in charge of about five enumerators. Thus each enumerator will have an average of four PSU's in which he will be required to list all holdings and to interview the assigned sample holdings. Since the supervisor must select the sample of holdings to be interviewed (and he must do this between the listing and interviewing operations for the PSU), the enumerator will not always be able to complete both operations for one PSU before starting another PSU.

3.1 *Listing*

During the listing operation, the enumerator will visit each housing unit in the entire PSU and will make a list of holdings operated by household members. The holding itself need not be located within the sample PSU. (See chapter 4 for further details on listing and sample selection).

3.2 *Preparing the sampling frame*

The supervisor will identify the holdings which are National Certainty holdings and delete them from the list which is to be used as a frame for sampling the small holdings. Any holdings of under 1/10 hectare which are identified in the listing will also be excluded from the sampling frame for small holdings. Finally, the supervisor will identify the holdings satisfying the criteria for Local Certainty holdings, which are similarly omitted from the sampling frame, since they will be included with certainty.

3.3 *Sample selection*

After the listing is completed and the frame prepared, the supervisor will use the sampling instructions for the PSU to select the sample of small holdings. He will also designate the Local Certainty holdings, and will assign any of the National Certainty holdings for which he wishes the enumerator to obtain questionnaires.

3.4 *Interviewing*

Enumerators will conduct interviews at all Local Certainty and sample small holdings in the PSU, and they will visit National Certainty holdings as assigned. Questionnaires will have been mailed, when possible, to each of the National Certainty holdings. The enumerator will review the questionnaire for completeness or, if necessary, will conduct an interview.

3.5 *Supervision*

The supervisor will make several visits to the enumerator to check on the completeness, and, insofar as possible, on the accuracy of the work done. Initially he may assign one or more PSU's to each enumerator, and he will assign additional PSU's as these assignments are completed. He will be responsible for collecting all completed questionnaires, Listing Books, and other materials.

4. *REASONS FOR VARIOUS FEATURES OF THE SAMPLE DESIGN*

The reasons for the principal features of the sample design are nearly all economic--either the reduction of costs through clustering the sample, or the reduction of total required sample size by methods which increase the efficiency of the sample. Many of the latter methods depend on the availability of advance information about the agricultural population.

4.1 Two-stage sample

The sampling of the small holdings in two stages greatly reduces travel costs, as compared with a smaller and less clustered sample of holdings that would have the same reliability. Another important reason for the use of two stages is the reduction in the cost of preparing a frame for the sampling of small holdings. For a single-stage sample of small holdings, it would be necessary to make a list of all of the small holdings in all PSU's in the universe. With a two-stage sample, it would be necessary to prepare such a list only for a sample of PSU's.

4.2 PSU'S of nearly equal size

With a known population of each EA, it was possible to sort out the very large and very small EA's, and to divide the large ones into more than one piece and combine the small ones. The purpose was to form primary sampling units (PSU's) of more nearly equal size (number of holdings) than the EA's in order to reduce the part of the sampling error resulting from variations in the size of PSU's. As described in chapter 3 of Unit IV, the procedure resulted in PSU's having an average of about 80 small holdings, plus a few medium-size and large holdings.

4.3 Stratification of PSU'S

The ordering of PSU's by agricultural characteristics is a form of stratification which makes it possible to select a more efficient systematic sample of PSU's. For example, if we list consecutively all PSU's in which cotton is produced, and select a 1-in-4 systematic sample, we will obtain a 1-in-4 sample of PSU's in which cotton is grown. Without the ordering, the 1-in-4 systematic sample might produce an accurate selection of cotton-producing PSU's, or due to sampling error it might not. Stratification by a meaningful ordering provides some control on sampling error.

4.4 National Certainty holdings

Since a list of the more important agricultural producers in Agrostan can be prepared, it is not necessary to risk having these holdings over- or under-represented in the sample. Large holdings and other commercially important holdings will all be included in the sample with certainty regardless of whether they are in the selected PSU's. For estimates of the total production of crops grown exclusively on estates or plantations, such as rubber and tea, the inclusion of these holdings with certainty will result in the complete elimination of sampling error. For other crops grown on these large holdings, their inclusion will substantially reduce sampling error, as illustrated in section 5.4 of this chapter.

4.5 Local Certainty holdings

A large number of holdings of intermediate size cannot be identified before the listing operation. These holdings may be so large that their combined agricultural production is an important share of the national or district total. Some of these medium-sized holdings will be in the sample PSU's, in which case they will be identified during the listing operation and will be included in the sample with certainty. A further reduction in sampling error will follow.

4.6 Stratification of holdings within sample PSU'S

A final control on the sampling error is provided by the size-of-holding classification which is obtained during the listing operation. As will be seen in chapter 4, the sample is selected separately from each of four size categories. Thus the sample will include the correct proportion of holdings from each size group and will be more representative of all the holdings in the PSU than is likely if the sample holdings are selected without stratification.

5. FIRST STEPS IN CALCULATING THE NUMBER OF SAMPLE HOLDINGS NEEDED

An indication of the thinking followed in arriving at the sample size for the average district is given below. This discussion, as well as the remainder of chapter 2, may be omitted by readers who are not interested in the mathematical considerations of the sample design.

5.1 *Size of sample required to estimate proportions with a simple random sample*

Consider an attribute which is possessed by about 50% of the holdings in any given district. An example might be the attribute of having any cattle. The size of sample required to estimate the percent of holdings having 1 or more cattle with a desired reliability from a simple random sample can be approximately determined from the simplified formula for the standard error of a proportion:

$$\sigma_{p:srs} = \sqrt{\frac{PQ}{n}} \tag{2.1}$$

where P is the proportion of all holdings having the attribute (.5 in this case), Q = 1 - P, and p is the proportion estimated from the sample. If we wish to have 95% confidence that the sample will estimate P within a 10% error (that is, within the range .45 to .55), then the error level $E = k\sigma_p = 10\%$ of $.5 = .05$ and k is 2 (multiple of σ_p needed for 95% confidence). Therefore we set

$$.05 = 2\sigma_{p:srs}\ , \quad \text{or}$$

$$\sigma_{p:srs} = .025 = \sqrt{\frac{PQ}{n}} = \sqrt{\frac{.5 \times .5}{n}} = \frac{.5}{\sqrt{n}}\ .$$

We find that a simple random sample of 400 cases is needed to obtain this degree of reliability. We have used the simplified formula for $\sigma_{p:srs}$ instead of the more exact one,

$$\sigma_{p:srs} = \sqrt{\frac{N-n}{N-1}\left(\frac{PQ}{n}\right)}\ . \tag{2.2}$$

The factor $\frac{N-n}{N-1}$ has been dropped, since it has a value slightly less than 1. The average district in Agrostan contains a total of about 6,000 to 7,000 holdings (N) and the simplified formula gives a slight overestimate of the size of sample needed to satisfy the requirements.

A simple random sample of 400 holdings, needed to estimate a P of .5 with specified accuracy, will estimate larger proportions more accurately and smaller ones less accurately.

5.2 *Effect of clustering on sample size*

We will not use a simple random sample in the design for Agrostan. Because of cost and travel considerations, the sample will consist of groups of holdings which are not so widely scattered as a simple random sample. Therefore, we will need a larger number of individual holdings than would be required for the same accuracy with simple random sampling. The sample of small holdings will be clustered in about 20 PSU's per district (one-fourth of all the PSU's into which the district will be divided). On the average, there will also be about 20 small holdings selected for the sample within each of the selected PSU's (one-fourth of all those in the PSU). This will result in an average of about 400 small holdings per district.

The effect of restricting the sample to selected PSU's is to increase the variance (squared standard error) of an estimated proportion compared with that of a simple random sample of the same size. The amount of increase depends directly on the degree of homogeneity (similarity) among the units in a PSU and on the average number of holdings selected within PSU's. The relation between the variance of a proportion estimated from a cluster sample (a two-stage sample) and that of a proportion estimated from a simple random sample is given by

$$\sigma^2_{p:cl} = \sigma^2_{p:srs}\left[1 + \delta\,(\bar{n} - 1)\right], \ \text{where} \tag{2.3}$$

$\sigma^2_{p:cl}$ = variance of p in a cluster sample of n holdings.

$\sigma^2_{p:srs}$ = variance of p for a simple random sample of n holdings.

δ (pronounced delta) = intraclass correlation coefficient, which is a measure of homogeneity of the holdings within the PSU's.

$\bar{n}$ = average number of sample holdings per selected PSU. In the Agrostan design this number will be about 20.

A thorough discussion of δ is beyond the scope of this unit. However, a number of sampling texts[5] provide good explanations of intraclass correlation. For the purpose of explaining the sample design for Agrostan, we can say that δ is a measure of similarity of the units within the PSU's. It nearly always has a value between 0 to 1, although small negative values are possible. The value of δ depends directly on the total number of small holdings per PSU (average of 80 in Agrostan); it is not affected by the value of $\bar{n}$, the average number selected in the sample.

Generally δ will be large for small PSU's where the holdings are likely to be similar, and it will be smaller for larger PSU's. There is a different δ for every characteristic estimated by the sample. Experience has shown that, for PSU's of 80 holdings, the value of δ for many agricultural characteristics can be expected to be about .05. This value will be used in the following discussion.

Substituting δ = .05 and $\bar{n}$ = 20 into equation (2.3) the variance of p becomes

$$\sigma^2_{p:cl} = \sigma^2_{p:srs}\left[1 + .05(20 - 1)\right]$$

$$= 1.95\,\sigma^2_{p:srs}$$

which is approximately $2\,\sigma^2_{p:srs}$.

Thus, if subsamples of 20 holdings are selected from sample PSU's having about 80 holdings, the variance will be nearly double that of a single-stage simple random selection of the same total number of holdings. We found above that a simple random sample of 400 holdings is needed for district estimates of desired accuracy. Therefore, if a sample of 400 holdings is clustered as described, it would have a variance twice as large as desired. We should, therefore, need a clustered sample of twice as many holdings, or 800 in the average-size district.

To summarize the effect of clustering, we have found that to obtain a specified standard of reliability twice as many holdings are required if the sample is clustered as in the Agrostan sample instead of being a simple random selection of holdings. This conclusion assumes a particular kind of clustering (PSU's of $\bar{N}$ = 80 and $\bar{n}$ = 20) and a typical degree of homogeneity (δ = .05). It is not limited to the case of P = .5 used in the examples although the results 400 and 800 are for that case. For characteristics having intraclass correlations larger than .05, the clustering will lead to larger sampling errors, and the size of sample needed for specified accuracy will need to be increased.

The number 400 is a first approximation to the size of sample needed for specified accuracy. It is a very rough approximation, since it does not take account of any of the ways in which the Agrostan sample departs from the simplest possible sample; namely, a simple random sample. Statisticians often begin to think of the size of sample needed by first calculating what would be needed with a simple random sample. This result is then successively modified to take account of the special features in the actual design, some of which have the effect of improving the accuracy as compared with a simple random sample of the same size, while other features (which are used to reduce costs) have the opposite effect of increasing sampling errors, or requiring a larger sample for specified accuracy.

The number 800 holdings is another approximation of the sample size needed. It takes account of one special feature of the design, which can be described by saying that the sample of holdings was clustered in selected PSU's, or by saying that it is a two-stage sample with PSU's as first-stage units and individual holdings as the second-stage units.

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[5] For example: Hansen, Morris H.; Hurwitz, William N.; and Madow, William G. Sample Survey Methods and Theory. Volume I: Methods and Applications. New York, John Wiley and Sons, 1953. Refer to chapter 6, section 8 of this text.

The specified accuracy level used here was 5% coefficient of variation for estimates of an attribute possessed by half the sample holdings. This is somewhat similar to the standard set in section 2.2 as the objective of the 1971 Agriculture Census. That level was a coefficient of variation of 5% for characteristics associated with half of all holdings. Assuming that half of all holdings have maize, an example would be the average hectares of maize. Such an estimate will be subject to a larger sampling error, and therefore will require a somewhat larger sample than is needed to estimate the percent of holdings having maize.

5.3 *Size of sample required to estimate averages and aggregates*

To determine the size of sample needed to estimate an average such as the average hectares of maize per holding, we can proceed by the same reasoning as above, but use the formulas appropriate for this type of item. Instead of formula (2.1), we can use formula:[6]

$$\sigma_{\bar{x}'} = \frac{\sigma}{\sqrt{n}} \qquad (2.4)$$

or, in relative form,

$$V_{\bar{x}'} = \frac{V}{\sqrt{n}}$$

where

$V_{\bar{x}'} = \frac{\sigma_{\bar{x}'}}{\bar{X}}$ = relative standard error (or coefficient of variation) of the mean

$V = \frac{\sigma}{\bar{X}}$ = relative standard deviation of the item in the population.

n = size of sample needed to estimate $\bar{X}$ with relative standard error $V_{\bar{x}'}$

For the type of items used to determine the standard of accuracy needed in the Agrostan census (namely, items occurring on half of all holdings), V might be as small as 1 (100%) or as large as 4 (a standard deviation 4 times as large as the mean). It could be even larger for items with a highly skewed distribution, where a few holdings have extremely large values.

Using $V_{\bar{x}'}$ = 5% as the desired relative standard error, we find that when V = 100%, this gives n = 400, the same as the size of simple random sample needed to estimate a proportion P = .5 with this relative error. Many items included in the census and occurring on about half or more of the holdings, will have much greater variability than V = 100%. They would, therefore, require simple random samples much larger than 400 (or clustered samples larger than 800) for the specified accuracy, if no modifications were made to improve the efficiency of the sample.

Estimates of aggregates, such as the total hectares of maize in the district, will require slightly larger samples for the same accuracy as averages. There are two sources of sampling error in an aggregate: (a) that resulting from error in the estimated average, and (b) that resulting from error in the estimated total number of holdings. With the Agrostan sample design the second source is almost entirely due to variability in the number of holdings between PSU's. To the extent that we succeed in controlling the variability from this source by equalizing the size of PSU's (see section 3 of chapter 3), we can expect that the number of holdings needed to make estimates of aggregates at a specified reliability will not be greatly different from that needed to make estimates of averages.

We conclude that, while a clustered sample of 800 holdings would be needed to estimate, with specified accuracy, a proportion P = .5, much larger samples would be needed to estimate many of the aggregates and averages for the various crops, livestock, and other items in the census. The next section discusses the expected effects of the special features in the Agrostan sample design which have the opposite effect from clustering, and thus reduce the size of sample needed for specified accuracy.

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[6] This formula assumes that the number of holdings (n) can be specified in advance and known exactly. In the actual application in Agrostan, there is a small sampling variability in n, which arises partly from the fact that the PSU's do not have exactly equal numbers of holdings, and partly from the fact that the numbers of holdings in PSU's is usually not exactly divisible by 4 (the sampling interval). However, for the present purpose, we can safely ignore these variations, and treat $\bar{x}$ as an average rather than as a ratio. The same is true of the proportion, p, discussed in section 5.1.

5.4 *Effect of special features in improving the efficiency of the sample*

As described in section 4 above, a number of special features were used in the sample design to improve its efficiency for a given sample size.[7] Probably the most important of these is the inclusion of all the extremely large holdings (National Certainty holdings) and the inclusion of all the medium-size holdings which are found in the sample PSU's (Local Certainty holdings). Inclusion of these holdings in the sample has a very great effect in reducing the errors in estimating averages and, consequently, in estimating aggregates. In the case of National Certainty holdings, their contribution to the total production is measured exactly, and the variability among the holdings remaining to be sampled (V in the formula of section 5.3), may be reduced to half its original value. To make estimates for the non-certainty holdings by themselves, therefore, the required sample size is only a fourth as large as would be needed to make estimates for all holdings with a uniform sampling rate for all. To make combined estimates for both types of holdings with specified relative error, an even smaller sample size will be adequate.

To see the possible effect of National Certainty holdings, consider an item such as total production of a specified crop. Assume this total for the district is 1,000,000 metric tons, and that the distribution is highly skewed and has a coefficient of variation $V = 400\%$. A sample of 400 holdings would estimate the mean $\overline{X}$ with a coefficient of variation of $\frac{400\%}{\sqrt{400}} = 20\%$. Assume that, after putting 50 very large producers on the National Certainty List, the remaining holdings have a total of 750,000 metric tons and a V of 200%. Then a sample of 450, made up of all the National Certainty holdings and 400 other holdings, would have no error in estimating the 250,000 metric tons associated with the National Certainty holdings. It would have a relative standard error of $\frac{200\%}{\sqrt{400}} = 10\%$ for estimating the mean for the smaller holdings and nearly the same relative error for estimating their aggregate. The absolute error (75,000 metric tons) for the non-certainty holdings is also the error in the estimated total for all holdings. As such, it is a relative error of $\frac{75{,}000}{1{,}000{,}000} = 7.5\%$. Thus the 20% error for a sample of 400 holdings was reduced to a 7.5% error by the designation of 50 National Certainty holdings. The Agrostan design is somewhat more complex, with Local and National Certainty holdings. The Local Certainty holdings, being a sample of a fourth of all such medium-size holdings, do contribute some error; but the net effect of both types of holdings may be about the same as in this example, since there are about 75 of these medium and large holdings in the average district sample.

We have already taken account of another feature of the sample design which greatly reduces the sampling errors of aggregates; that is, the approximate equalization of the size of PSU's (in terms of number of holdings).

The remaining special features--mostly various forms of stratification--improve the estimates of both aggregates and averages or proportions.

When the effects of all these special features are considered, it is reasonable to expect that the Agrostan sample will satisfy the required standard of accuracy. That sample in the average district has about 475 holdings, including 400 small holdings, 50 Local Certainty (medium-size) holdings, and 25 National Certainty (very large) holdings.

5.5 *Effect of a constant overall sampling rate on district sample size*

To control the number of weights required to tabulate the results, the sample of small holdings will be selected at the same overall rate (1 in 16) throughout the 13 Provinces. This will result in an expected sample as small as 150 holdings in the smaller districts (or combined districts) and as large as 1,000 or more holdings in the larger districts. Therefore, even the characteristics with high δ's or those which can be associated with only a small proportion of the holdings can be estimated with the desired reliability in the larger districts. In contrast to this, all estimates for small districts (with 150 to 300 sample holdings) will probably have coefficients of variation larger than 5% and should be used cautiously. A coefficient of variation greater than 5% will normally be acceptable for characteristics associated with smaller proportions of the holdings as well as for all characteristics in small separately published districts. (It will be recalled that the smallest districts are not separately published, but are combined with other districts for publication.)

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[7] The use of a two-stage sample (clustering) is also for the purpose of improving efficiency, but in that case the efficiency is a result of the fact that a larger sample can be obtained for a given cost.

5.6 Sample size for cross-classifications

The warning that a comparatively larger relative error must be tolerated for characteristics belonging to small proportions of the population is particularly applicable to cross-classifications. Suppose, for example, that each of five different size-of-holding classes are subdivided into three type-of-holding categories. Estimates of characteristics for these subgroups in an average district would be based on a sample of about 30 holdings rather than 475. Quite obviously, the relative sampling error for each of these 15 estimates would be much higher than for estimates based on the entire sample.

In setting up the tabulation plans, therefore, the expected number of sample holdings in various subgroups must be considered. Generally speaking, the number of cells in a table should be small enough so that most cells are represented by at least 30 to 50 holdings. The 1961 Census results can be used as guides for establishing tables for publication which meet this requirement.

5.7 Summary

In summarizing the discussion on sample size, it must be emphasized that there is no standard procedure for deciding sample size for sample censuses where a large number of estimates are to be made. Each characteristic is distributed among the agricultural holdings differently. Even if the standard error for each characteristic were known, it would not be possible to arrive at a single sample size which would provide all estimates at any one specified level of reliability. However, a sample of 475 holdings has been determined on the basis of experience in agricultural surveys and supported by the above discussion, to be sufficient to provide estimates of most of the more important characteristics such that the coefficient of variation will be no greater than about 5% (10% error at the 95% confidence level). It is assumed that a greater sampling error is acceptable for less common characteristics.

The value assumed for the intraclass correlations and for the relative standard deviation in the above examples are believed to be roughly accurate for many agricultural characteristics for clusters of 80 holdings. However, these are only intelligent guesses based on experience in a few countries. In order that required sample sizes can be more accurately determined for the next agriculture census and for intercensal surveys, variance calculations for a few characteristics should be a part of the processing plan for the 1971 Agriculture Census of Agrostan.

6. DETERMININATION OF THE NUMBER OF FIRST- AND SECOND-STAGE SAMPLE UNITS NEEDED

The reader, at this point, has probably accepted the fact that a sample of 400 small holdings selected from 20 clusters and supplemented by the certainty holdings and improved by the other features as described, will provide reliable district estimates in the sample census. He may be asking himself, "Why not select a smaller but more widely distributed sample of holdings?" For example, a smaller total sample size would be required for the same level of reliability if the holdings were selected from a larger number of PSU's giving a smaller $\bar{n}$ and $\sigma^2_{p:cl}$ in Equation (2.3). The larger but more clustered sample can be justified, however, when costs are considered together with the reliability requirements.

6.1 Types of census costs

Costs of the census can be broadly grouped into: (a) overhead costs, (b) costs which vary in proportion to the number of sample PSU's, and (c) costs which vary in proportion to the number of sample holdings.

6.11 Overhead costs.--This category includes costs of the central administrative and technical work on the census. Almost all of the overhead costs are present whether a complete census or sample is used. They include the costs of the operation of the National Statistical Office and the cost of operating the regional agriculture census offices in the field. For the purpose of optimizing the sample design of the agriculture census, the overhead costs will be assumed to be constant under alternative sample designs.

6.12 PSU cost.--The following are examples of items contributing to costs which vary in proportion to the number of PSU's:

(1) Preparing sample materials (maps, etc.) for selected PSU's.

(2) Travel between PSU's and locating PSU's.

(3) Listing the PSU's.

(4) Selecting the sample of holdings.

(5) Supervisors' salaries (part).

6.13 Sample holding costs.--The following are examples of costs which vary in proportion to the number of sample holdings:

(1) Interviewing the sample holdings.

(2) Printing questionnaires and other forms.

(3) Editing and coding.

(4) Tabulating.

(5) Supervisor's salary (part).

(6) Travel within the sample PSU's.

6.2 Determining the cost function

In practice, it is not an easy task to divide the total costs into the three categories, but usually the different types of costs can be roughly determined and their values estimated. If the sample census were a continuing survey in which information on costs could be collected, the sample could be changed to a more nearly optimum design after the first results are available. For a one-time operation such as a census, care should be taken to make fairly accurate cost assumptions.

There is very little available data in Agrostan on which to base assumptions of costs. Therefore, intelligent guesses must be made of the average cost per PSU and the average cost per sample holding included in the census. Since overhead costs are assumed to be constant whatever the sample design, only the PSU costs and the sample holding cost (that is, the variable costs) will affect the optimizing of the design. The relationship between these costs is important.

It is obvious from looking at the sources of costs that the unit cost related to sample PSU's is much greater than the unit cost related to sample holdings. Much work is required to prepare the maps and other sampling materials for the sample PSU's. Motor vehicles must be used by supervisors to travel between PSU's and each enumerator will require some means of transportation primarily for travel between PSU's. Travel costs between PSU's, including the cost of vehicle maintenance, are among the largest costs of the census. Also, the listing of the sample PSU's, which requires a large proportion of the enumerators' time, and the selection of the sample holdings by the supervisor, will add much to the expenses per sample PSU. These and almost any other costs which vary in proportion to the number of PSU's are normally quite large.

The total cost associated with the sample holdings has some large components. Interviewing, editing and coding, tabulation, and printing may all be very expensive operations. When the total of these costs is divided by the number of sample holdings, the resulting unit cost will probably be much smaller than that for PSU's.

Under the conditions which prevail in Agrostan, the ratio of the unit cost for PSU's to the unit cost for sample holdings can be expected to be roughly about 20 to 1. Assume that the cost (C_1) of including a PSU is $40 and the cost ($C_2$) of including one sample holding in the census is $2. Then the optimum design contains the number of sample PSU's (m) and sample holdings within PSU's ($\bar{n}$) which minimizes the total variable cost for the desired level of reliability. The formula for the cost function is given below:

$$C_1 m + C_2 m\bar{n} = C - C_o \qquad (2.5)$$

where: C_1 = unit cost per PSU, based on the costs related to the number of sample PSU's

C_2 = unit cost per holding, based on the costs related to the number of sample holdings

$C - C_o$ = total cost minus overhead cost (total variable cost)

m = number of PSU's in the sample

$\bar{n}$ = average number of holdings per sample PSU.

6.3 Determining the number of PSU'S and the average size of subsample

The value of 20 for $\bar{n}$, the average size of subsample to be selected within a sample PSU, was obtained by a rough method of optimizing described in exhibit IV-2-8. It uses trial values of $\bar{n}$, various assumptions consistent with those developed in section 5 above, and unit costs as in section 6.2. Resulting values of m (the number of PSU's needed) and of $C - C_o$, the total variable cost, are then found. We then choose a value of $\bar{n}$ which is close to the optimum and is a convenient fraction of $\bar{N}$ (the total number of holdings in the average district). In this case the fraction $\frac{1}{4}$, giving $\bar{n}$ = 20, was chosen. The value of m was also obtained by choosing a value of m close to the optimum, which is a simple fraction of the number of PSU's in the average district; m also was $\frac{1}{4}$ in this case. Thus the sample in the average district consists of about 20 PSU's each with about 20 small holdings, but it is the fraction ($\frac{1}{4}$) which is held constant--not the number 20. This assures us of having a probability sample of all holdings, with the following probabilities of selection and weights for the three categories of holdings:

Category	Probability of selection	Weight
Small holdings	$\frac{1}{4} \times \frac{1}{4} = \frac{1}{16}$	16
Local Certainty holdings	$\frac{1}{4}$	4
National Certainty holdings	1	1

7. REMARKS ON SAMPLE DESIGN

The planners for the Agrostan Census of Agriculture are fortunate in being able to use the 1970 Population Census EA's to form PSU's. Otherwise the cost of forming clusters would have been greater and a different PSU size (greater or smaller than the EA) might have been chosen. With a smaller or larger PSU, the value of δ for each characteristic would be different. For example, if smaller clusters than 80 holdings were used, the values of δ would generally be higher. Larger clusters usually have many characteristics with low values of δ. This is true, primarily, because small clusters contain holdings which tend to be similar. Large clusters are more variable, and are usually more efficient for countries like Agrostan where the cost of including a PSU in the sample is very high.

With some general knowledge of the measures of homogeneity, it is possible to assume a typical value for δ which is reasonably accurate for most of the important characteristics in the census. Assumptions of costs can be based on experience in agriculture surveys, and an approximately optimum design for making estimates of many different types of characteristics can be determined.

If work on the sample design can be started early enough, it would be highly desirable to base cost estimates and other assumptions on results of a pretest. This might be made in one district selected by judgment to best serve the purpose.

Chapter IV - 3. SELECTING THE SAMPLE OF FIRST-STAGE UNITS

1. INTRODUCTION

With the sampling plan for the Provinces established, work can begin on the selection of the sample units. This work can be divided into four major operations, each of which is made up of smaller operations. The four major operations are: (a) identifying the National Certainty (NC) holdings, (b) forming a frame of PSU's, (c) selecting the sample PSU's, and (d) listing all holdings and selecting sample holdings within the sample PSU's. The first operation is partly an office and partly a field operation; the second and third operations are primarily office functions; these three operations will be described in this chapter. The last operation is done in the field and will be described in the next chapter.

2. NATIONAL CERTAINTY HOLDINGS

An example of the importance of the National Certainty holdings in making census estimates has been given in section 5.4 of chapter 2. Because of their importance, the identification of the large agricultural producers for the National Certainty list will be given high priority in the early stages of census work. From a sampling point of view, the National Certainty holdings can be considered as a separate universe or population which is completely enumerated in the census. The problems are (a) to define this population clearly, (b) to construct an accurate list of the units it contains, and (c) to insure that no holding will have a chance of being in both the National Certainty list and the list from which the sample holdings are selected. Exhibits IV-3-1 and IV-3-2 list the large holdings in Ranchi District in Rajpur Province.

2.1 Definition

National Certainty holdings will be defined as (a) all known agricultural holdings with more than 500 hectares of land, and (b) all known agricultural holdings of any size on which important special crops are produced or which are important in the livestock or poultry production of the country. Holdings of less than 500 hectares which would qualify as National Certainty holdings include nurseries and greenhouses producing stock for sale, holdings producing silk fiber, holdings with 5,000 or more poultry, dairy holdings with 100 or more milk animals, feedlots with 500 or more animals, and all government-owned experimental holdings. Based upon the 1961 Census results, about 3,600 holdings that are large or have specialized agricultural operations will be listed. After the list of National Certainty holdings is prepared, deletions and additions generally would not be permitted. (See section 2.4 below for exceptions.)

Some districts will have many large holdings, of which only the very large holdings would be included as National Certainty holdings. Other districts will have no very large holdings but smaller holdings which will be included because of their specialized agricultural activities. Estimates made for the nation as a whole would be quite reliable with a much shorter list of large holdings. Reliability of the estimates for a district will, however, depend greatly on the National Certainty holdings in the district.

2.2 Sources of data

Most of the major contributors to the agricultural activities of a district will be obvious to the person preparing the list of National Certainty holdings. The large estates and plantations are usually well known throughout the district in which they are located. In addition, a systematic search should be made of as many sources as possible in order to find the other large, but less well-known, agricultural producers. Some of the major sources of information are given below.

2.21 List of 1961 large holdings.--Holdings of 500 hectares or more enumerated in the 1961 Sample Census of Agriculture will be listed by the NSO staff and provided to the District Agricultural Agents who will compile the 1971 lists. The 1961 list will provide the starting point, (see exhibit IV-3-1) and the Agricultural Agents are required to account for each 1961 holding and add all other holdings which meet the requirements for the 1971 Census. The 1971 lists are compiled several months before the start of the field enumeration.

2.22 The Ministry of Agriculture.--Officials of the Ministry of Agriculture have frequent contacts with operators of large holdings. A few Government officials specializing in the main commercial crops are, therefore, likely to have lists of major producers and their locations.

2.23 Local officials.--At the district level, the operators of large holdings work closely with local officials in the production and marketing of their crops. Agricultural Agents and other district officials will know most of the important holdings in their areas.

2.24 Associations and cooperatives.--The growers of specialized crops such as coffee and tea will probably be members of associations and cooperatives. Many of these growers will already be on the list of National Certainty (NC) holdings which was obtained from other sources; however, by comparing the association and cooperative memberships with these other sources, a few additional large holdings may be added to the list.

2.3 Small holdings erroneously included

Because of inaccurate information, some small holdings which are not very important to the census may be included in the list of NC holdings. The cost of locating and conducting interviews at these holdings may be very high in proportion to their importance, but there will be no bias caused by including them. Once a holding is placed on the list of NC holdings and excluded from those listed in the sample PSU's (in the Listing Book), it should be retained and treated the same as other NC holdings. If such holdings are reclassified after selecting the sample of small holdings it is very difficult to avoid a bias in the estimates from the sample.

2.4 Large holdings found after 1971 lists are compiled

After the District Agricultural Agents compile the 1971 lists of NC holdings (see exhibit IV-3-2), the lists are sent to the NSO for distribution to the field supervisors for the census. As one of the preliminary field operations, the census supervisor is required to spot the NC holdings on his map of the district so that he can appropriately assign them to the enumerators for completion of the Agriculture Questionnaires. At the same time, the supervisor is to search for very large holdings of 1,000 hectares or more which are missing from the district list. He makes this search in all PSU's in the district (not only in sample PSU's), adds such holdings to the NC list, and assigns them for enumeration. They will thus carry a weight of 1 in the analysis of census data.

If an enumerator finds a large holding of 500 hectares or more in a sample PSU (for example, a holding of 600 hectares or one of over 1,000 hectares which was missed in spite of a search by supervisors), he should list it in the usual way and it will be treated as a Local Certainty holding. It will then carry a weight of 4, since we must assume that only a fourth of all such holdings would be discovered within the sample PSU's. If local information makes it seem almost impossible that there are other such holdings in non-sample PSU's comparable to one found in a sample PSU, it might in exceptional cases be safer for the supervisor to add such a holding to the National Certainty list, thus giving it a weight of 1.

The procedure described above was adopted for Agrostan in order to keep the sample as unbiased as possible. Other criteria could be used, such as a cut-off point higher or lower than 1,000 hectares for the supervisor's search.

3. SAMPLE OF PSU'S

The holdings which appear on the list of the NC holdings will be included in the sample with certainty. A sample will be selected from all other holdings in the country, and interviews will be conducted only at these sample holdings and the NC holdings. To control the amount of travel between interviews, the sample holdings will be clustered in selected primary sampling units (PSU's). Thus, the other-than-NC holdings will be selected in two stages: first, a sample of PSU's, then a subsample of holdings within the selected PSU's.

A considerable amount of preparatory work must precede the actual selection of PSU's. This will require the use of any available information about the PSU's and of materials from the 1970 Population Census. The preparatory work will be done in the following steps:

(1) A sampling frame is prepared by forming PSU's from the 1970 Population Census Enumeration Areas (EA's).

(2) The PSU's are arranged in order (stratified) for selection of the sample.

These steps must be performed for each district in the 13 Provinces.

3.1 Forming the PSU'S

PSU's will consist of 1970 Population Census EA's or of units formed from the Population Census EA's using the EA maps and preliminary 1970 population counts (see exhibits IV-2-1 and IV-3-6 for Ranchi District in Rajpur Province). As they are formed, PSU's are listed on the PSU Sample Selection Sheet (exhibit IV-3-8), or they are recorded on cards (see section 3.14 below). The limits of the 1970 EA's will be used as the boundaries of PSU's; where EA's are subdivided, physical boundaries such as roads, rivers, and other natural boundaries which can be clearly seen and definitely identified by the enumerator should be followed. Because of special problems which exist in the urban areas and in very remote rural areas, definitions of PSU's will be slightly different from those used in the ordinary rural areas. Ultimately, a sampling frame of PSU's covering the entire universe will be available.

3.11 Rural PSU's.--Most of the 1970 Population Census EA's which are located in the rural areas will be acceptable as PSU's without modification. As shown in section 1.4 of chapter 2, these EA's on the average contain 515 persons and 85 holdings[1] of 1/10 hectare or more. However, there will be a few EA's which are much smaller or much larger than the average EA. Modifications of these EA's will be required, therefore, to form PSU's closer to the average size. For this purpose, we use population data and assume that by approximately equalizing population we will approximately equalize the number of holdings.

For equalizing PSU's, the convenient number of 500 persons (rather than 515) was chosen as the desired average size of PSU. This will correspond to about 83 holdings. To prevent excessive variation from the average size PSU, a minimum PSU size of about 300 persons and a maximum PSU size of about 700 persons will be established. Almost all of the modifications of the EA's will result from this size limitation. Of the average of 83 holdings, about 3 will be Local or National Certainty holdings, leaving about 80 small holdings in the average PSU.

Exhibit IV-2-2 shows the distribution of rural EA's by population in Rajpur Province, which is a typical Province. Most of the EA's in this Province already fall within the limits required for rural PSU's. We will need to combine some of those which are very small and divide into more than one piece some of those which are very large. The combinations will always be made with EA's sharing a common boundary. The divisions will in some cases form two or more separate PSU's. In other cases, two PSU's in combination will be divided into a total of three parts. The preliminary population counts for EA's in Ranchi district (in Rajpur Province) are shown in exhibit IV-2-1.

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[1] The figure 85 is a rough estimate based on data and guesses from several sources. The 1970 Population Census did not obtain information on the number of holdings; therefore, data from the 1960 Population Census and the 1961 Sample Census of Agriculture were used. Exhibits I-2-34 and I-2-35 indicate an average of 5.5 persons per rural housing unit. Unpublished data from the 1961 Census indicate that the ratio of housing units to holdings of 1/10 hectare or more was about .91 in the EA's defined as rural. Thus, (515 X .91) ÷ 5.5 = 85. Exhibits IV-2-6 and IV-2-7 provide more detailed estimates by Provinces and districts, combining the rural and urban portions that would be in the sample.

There is a special set of rules for forming PSU's from rural EA's where travel will be very difficult and the cost of including them in the sample census will be very high. The objective here is to make PSU's which are somewhat larger in terms of number of holdings, and thus to have fewer of this type of PSU in the universe and in the sample. The average size of these less accessible rural PSU's will be approximately 700 persons with a lower limit of about 500 and an upper limit of about 900. They are referred to as "remote" in the urban/rural classification of PSU's. Sometimes the EA's can be divided into more than one piece with the use of the EA map (see exhibit II-3-4). In most cases, however, some field work is required to divide the EA. This field work would be quite costly if every such EA map were taken to the field for division. Therefore, a method has been devised which requires a large EA to be divided only if it falls into the sample.

3.12 Measures of size.--Each single PSU will be assigned a measure of size of one. Where an EA needs to be divided into several separate PSU's, two or more measures of size will be assigned. If an EA is not of an appropriate size for simple division or combination, or if the map boundaries do not permit it, variations of this procedure will be used. As stated above, it may be necessary to put two EA's together and assign three measures of size to the combined PSU. Such combined PSU's will be divided only if selected in the sample. The measures of size will be cumulated and sampled systematically as described in section 3.3 below. By doing the additional field work of dividing the PSU's only if one of these combined PSU's falls into the sample, a considerable savings in field work will result.

3.13 Urban PSU's.--The 1970 Population Census EA's were larger in the urban areas than in rural areas (see exhibit IV-2-3); however, the percentage of households associated with holdings is much smaller in urban areas. This percentage may vary according to the size of the urban place and the degree of urbanization in the area surrounding the city or hamlet.

In examining the urban places, the NSO staff felt that a high proportion of households in the smaller urban places would have some agricultural operations and thus qualify as holdings. Therefore, they decided that places under 5,000 population (according to the 1970 Census of Population) would be treated the same as rural EA's.

Urban places with a population of 5,000 or over will be treated differently. The built-up sections of such cities and hamlets will be excluded from the universe (as explained in chapter 1 of Unit II).[2] The assumption here is that the cost of listing and enumerating holdings in the city will be much too great when compared with the contribution of these central urban areas to the agricultural statistics of the country.

In order to exclude the built-up sections of large urban areas and to form PSU's of the remainder of urban areas, maps of the cities showing the 1970 Population Census EA's will be required (see exhibit IV-3-5). The PSU's can be formed on the map by combining EA's, or parts of EA's, to obtain PSU's of about 80 holdings.

EA's in the larger urban places contain on the average about 1,000 persons or approximately 200 households. The person preparing the PSU's from these EA's will accept the entire EA as a PSU without change if in his judgment it contains approximately 80 holdings. As in the case of the rural and small urban areas, the 1970 Population Census EA's should in most cases make satisfactory PSU's; but when supplemental information indicates that an urban EA has more or less agricultural activity than usual, modifications of the EA's will be necessary. The modification should then be carried out in the same manner as in forming PSU's in the smaller urban places, except that a judgment on number of holdings will be used instead of the minimum and maximum population limitation.

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[2] National Certainty holdings which are located in built-up areas would, however, be included in the census.

3.14 PSU card.--After the PSU's are formed and listed, the sample PSU's can be selected. In some districts, the selection can be made directly from a listing of PSU's entered in numerical order on the PSU Selection Sheet, Form A-261 (see exhibit IV-3-8). In other districts, however, where there is a great variety of agricultural activities, important gains in reliability can be obtained by further stratifying (ordering) the PSU's by characteristics related to agriculture, before selection. In these districts, the preparation of PSU cards will facilitate the stratification. A PSU card will be required for each single PSU and one for each pair or combination of PSU's, showing the measure of size.

Not much data will be available from the 1970 Population Census which can be transcribed to the PSU card; however, through the use of maps and general knowledge of the district, some information about each PSU in the district may be available. The items of information which can probably be obtained for each PSU appear on the PSU card shown as exhibit IV-3-4. They include the following:

Items (a) through (g).--These items identify the PSU. The Sample PSU Numbers are a set of consecutive numbers for the selected PSU's, numbered in the order drawn. The Card Numbers are simply a set of consecutive numbers assigned to the PSU's after they have been stratified (ordered).

Item 1, Population.--Enter the preliminary 1970 Population Census count.

Item 2, Measure of size.--Enter the measure of size for the PSU.

Item 3, Urban/rural.--Check urban or rural as defined for the 1970 Population Census, except to designate certain rural PSU's as "remote." Rural PSU's which appear on a topographical map to be in mountainous areas or in isolated, undeveloped areas will be classed as "Remote."

Item 4, Elevation.--The average elevation in broad class intervals can also be taken from a topographical map of the district.

Item 5, Type of agriculture.--The person preparing the PSU cards must exercise some judgment based on a knowledge of the district to describe type of agriculture. If the PSU is located in an area containing crops which are different from those grown in the rest of the district, he will enter the type of crops grown in the PSU. For example, cotton is often grown near rivers, in low-lying areas; if it is known that cotton is grown in the PSU's located along the river in a particular district, the word "cotton" will be entered in this item for the appropriate PSU's.

Item 6, Remarks.--This item may be used to record any unusual or unique features of the PSU.

3.2 Stratification and listing of the PSU's

The 1970 Population Census EA's have been numbered so that those which are near each other are consecutively listed. A listing of resulting PSU's on Form A-261 following this order will provide a geographic stratification, which will be the only stratification needed for most of the districts. However, as mentioned in section 3.1 above, there will be some districts in which PSU's are not similar to their neighboring PSU's, but are more nearly like other PSU's in the district; these are the districts for which PSU cards were prepared. The final stratification in these districts will result in reordering the PSU's so that they can be listed on Form A-261 with similar PSU's appearing consecutively. The PSU cards will be sorted using items 3, 4, and 5 and the remarks item. Item 1 (Total population) should have been made approximately equal for all PSU's when the 1970 Population Census EA's were modified to form PSU's. Therefore, the first step in the stratification of each district is to inspect item 3 (the Urban/rural code) for all cards in a district, and to group together cards for urban PSU's, followed by rural PSU's, then remote PSU's. Then the cards are sorted by item 4 (Elevation) within each urban/rural group. After this is completed, the stratification might require further refinement using item 5 (Type of agriculture), and item 6 (Remarks).

The information in item 5 will be incomplete since there will be no entry for most PSU's. However, items 5 and 6 may show that there are some specialized crops grown in various parts of the district. If so, the cards should be rearranged, placing together those PSU's in which specialized crops are grown (without regard to urbanization and elevation). The following illustrates stratification for a district which has several different types of agricultural activities.

Sub-district	EA No.	Urban/ rural	Elevation	Type of agriculture
01	001	Urban		
	002,003	Urban		
	004	Urban		
	005	Urban		
	006,007	Urban		
	008	Urban		
02	001	Rural	Lowlands	Rice
	002	Rural	Lowlands	Rice
	003,007	Rural	Lowlands	Rice
	006	Rural	Lowlands	Rice
03	001	Rural	Lowlands	Rice
	006	Rural	Lowlands	Rice
02	004	Rural	Lowlands	Rubber
	005,008	Rural	Lowlands	Rubber
03	005	Rural	Lowlands	Rubber
	007	Rural	Lowlands	Rubber
	002	Rural	Lowlands	Sugarcane
	003,004	Rural	Lowlands	Sugarcane
	009	Rural	Lowlands	Sugarcane
	010,011	Rural	Plateau	Cattle
04	003	Rural	Plateau	Cattle
	004	Rural	Plateau	Cattle
	005	Rural	Plateau	Cattle
	008,009	Remote	Plateau	Sheep
	010	Remote	Plateau	Sheep
03	008	Remote	Plateau	Sheep
04	001	Remote	Highlands	Sheep
	002	Remote	Highlands	Goats
	006,007	Remote	Highlands	Goats
	011	Remote	Highlands	Goats
	012	Remote	Highlands	Goats

The greatest gain in the stratification process will result from the geographical ordering of PSU's produced by the numbering system. For this reason the further stratification of the PSU's (and the preparation of PSU cards) should not be allowed to consume a large proportion of the total census resources or of the professional time of NSO statisticians. It should be noted that the rearrangement of the PSU's by the first one or two items will produce most of the additional gains from stratification. If accurate information is available on all four items, additional gains will result from refining the stratification by these items. The information required for this deeper stratification will be available for only a few districts in Agrostan.

3.3 *Selecting sample PSU's*

After the PSU's are formed and ordered into homogeneous groups, they are listed along with their measures of size on Form A-261; then the sample PSU's can be selected. Several different methods could be employed in selecting a sample of PSU's. In choosing the method of selection for Agrostan, reliability and convenience were important considerations. The adopted method of selection produces an efficient sample for district estimates; also the selection procedure and estimating methods are easy to apply.

For the Agrostan sample, the sampling interval was determined by the reliability requirements for the average district. In section 6 of chapter 2, it was explained that an average of 20 sample PSU's from the average total of 80 PSU's per district is the desired sample size. Thus, the sampling interval needed in the average district for selecting the PSU's is 4. In order to keep the sample self-weighted, this same interval will be used in all districts. It will produce fewer than 20 PSU's in small districts and more than 20 in large districts, with resulting variations in expected sampling errors.

A random start between 1 and 4 will be selected for the first district. Every fourth PSU in this and the remaining districts will then be selected. When the last PSU in the first district is selected, either 0, 1, 2, or 3 PSU's will remain in that district. These will be counted in finding the first sample PSU in the second district. Thus, if two PSU's were remaining in the first district, then the second PSU of the second district (the fourth since the last previous selection) will be the starting point in that district. In other words, the selection is carried out from a continuous list of PSU's and not separately within each district.

The selection of PSU's is illustrated for Ranchi District in Rajpur Province in exhibit IV-3-8 (Form A-261). After the PSU's are ordered as described above, the sample PSU's will be selected systematically from the cumulated measures of size (equal probability except where a PSU has a measure of size other than 1). Since the sampling interval has been set at 4, a random starting number from 1 to 4 is selected to identify the first sample PSU, and then the remaining units are identified by successively adding 4. For example, if the random start is 3, the selected PSU's will be those corresponding to the measures of size numbers 3, 7, 11, 15, etc.[3]

In exhibit IV-3-8, the "start with" number is "3" (assuming a carry-over of "1" from the previous district) and the "take every" is "4". Thus, the first sample PSU is EA 002 in subdistrict 01. (Note that EA 001 has 2 measures of size.) The second sample PSU is the second part of EA 005 in subdistrict 01 (since EA 005 has 2 measures of size).[4] The third sample PSU is EA 006 in subdistrict 02; the fourth is EA 009 in subdistrict 02; etc. The sample PSU No. in column 7 starts with 01 in each district.

This method of selection of PSU's permits the use of a simple estimation method. The Local Certainty holdings will all have the same weight, namely 4. If the PSU's were selected with unequal probabilities, it would be possible to keep a constant overall probability for small holdings, but it would be necessary to vary the weights which must be applied to Local Certainty holdings in different PSU's. This would make the tabulation of the census results much more difficult and would be subject to errors in weighting.

The efficiency of the systematic selection of PSU's results mainly from the fact that it produces nearly the same sample proportion--namely one fourth--of the PSU's from each of the homogeneous groups formed in the stratification process.

After the sample PSU's are selected they are given a sample PSU number in column 7 of Form A-261. The sample PSU's are listed on PSU Control Record for Map Preparation, Form A-271 (see exhibit VI-2-4, which is included in this unit as a reference exhibit) and copies are sent to the Geography Division for appropriate action. Exhibit II-3-6 shows the map of the sample PSU's for Ranchi district in Rajpur Province.

Form A-252 (exhibit IV-3-7) is a District Summary of the number of PSU's and National Certainty holdings in the sample. It is used by the Field Division to inform the Province Census Offices (and district supervisors) of the number of sample PSU's in each district.

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[3] We refer to the method as sampling with equal probability, since in the cases where measures of size are not 1, the PSU finally formed after subdivision will have had the same probability of selection as all others.

[4] The two parts are numbered by a random process as first or second parts.

Chapter IV - 4. LISTING WITHIN THE SAMPLE PSU AND SELECTION OF THE SAMPLE HOLDINGS

1. INTRODUCTION

The major reasons for selecting the sample holdings in two stages were discussed in chapter 2 of Unit IV. The first reason is the substantial saving in travel costs of enumerating a sample of holdings selected in two stages as compared with a one-stage sample of individual holdings which would provide the same reliability.

The second reason for selecting the sample in two stages is the reduction in the amount of work to prepare the frame of holdings. To select the sample in one stage, a list of all holdings in the country would be required. Such a list is not available, and preparing one for the entire country would be not only expensive but also impractical. It is practical, however, to prepare a list of holdings which are located in a sample of PSU's. Thus, for the Agrostan Sample Census of Agriculture, a sampling frame (list of holdings) is required for each sample PSU so that a sample of holdings can be selected from each. In this chapter, the steps involved in preparing the sampling frame for each selected PSU and for selecting the sample of holdings will be discussed and illustrated.

2. LISTING

The preparation of the sampling frame of holdings for a PSU begins with making a list of all the housing units in the PSU. This is done in the "listing" operation through the use of the Listing Book Form A-2a (see exhibit IV-4-1). One line of the Listing Book must be filled for each housing unit in the PSU. On this line, certain information is recorded for each housing unit, which determines whether or not the housing unit identifies an agricultural holding; that is, whether any member of the household operates an agricultural holding, either on his own account, in partnership, as a hired manager, or as a chieftain.

2.1 Relation between housing units, holders, and holdings

The reasons for associating a holding with a housing unit and with a particular household member (the holder) were discussed earlier in the case study (chapter 1 of Unit II and chapter 1 of Unit III). One of the most important reasons is that census information must be obtained from the holder or a member of his family. Where the holder does not live on his holding, it is easier to find him by way of his housing unit than by way of his holding.

Some housing units will not be associated with holdings, since they will have no household member who operates a holding. These are the housing units with answers of "No" in both column 4 and column 5 of the Listing Book.

A few households may have two or more members, each of whom has a separate holding. The Listing Book provides for listing the second holder (and each successive holder) on separate lines (see the instructions at the top of column 6 of the listing page).

There may also be cases where a single household member operates more than one holding. If so, the separate holdings are listed on separate sub-lines beginning with column 7.

With this listing procedure, there may be a few holdings inside the PSU which are not included in the sample frame for the PSU, because the holders live outside the PSU. They would be included in the sampling frame for the PSU in which they live. Thus they will have their proper probability of inclusion in the sample.

The final frame of holdings to be sampled in the PSU consists of all the holdings listed in the PSU, except for those defined as out-of-scope for the census, as described in section 2.3 below.

Exhibit IV-4-1 illustrates a Listing Book in which each housing unit in PSU 19 of Ranchi District (Rajpur Province) is listed in column 3, and each agricultural holding associated with the housing unit is listed in column 7. The information on size of the holding identifies holdings which are out-of-scope of the census; it is used also for stratification of holdings by size.

2.2 *Definitions of holder and holding*

Many of the problems in sampling agricultural holdings arise from the difficulties of defining a "holding" in such a way that every piece of agricultural land will have one and only one chance of being selected in a sample. This requires a definition that will (a) associate every piece of agricultural land with one and only one holding, and (b) identify that holding with one and only one PSU.

A precise definition of a holding is given in Unit III of the case study and the definition is applied in questions 5 to 14 of the Agriculture Questionnaire, Form A-la. Generally, a holding is one or more plots of land, operated as a single unit, on which crops or livestock are produced. The holding may be operated by an individual on his own account; it may be operated by a hired manager, a chieftain, or by a partnership. There is thus a one-to-one relation between holdings and holders except for (a) partnerships, in which a single holding is associated with more than one holder, and (b) holders who operate two or more separate holdings.

In order to associate each holding with one and only one PSU, we use the house where the holder lives to decide with which PSU the holding should be associated.

In the case of partnerships, if the partners live in the same household, the instructions at the top of column 6 of the Listing Book provide for making only one listing in column 7; for example, line 6 on page 1 of the listing pages in exhibit IV-4-1 lists two partners for one holding. If the partners live in separate households, the instructions on the Agriculture Questionnaire itself will eliminate the holding if any partner other than the "principal partner" is selected for the sample (see question 2 of Form A-la). Thus, the holding is associated with only one PSU--that in which the principal partner lives.

In the case of holders who operate two or more holdings, each such holding, wherever it may be located, is included in the listing for the PSU in which the holder lives. For example, the holder listed on line 9 of page 1 of the listing pages in exhibit IV-4-1 has two holdings. One is a small holding of 2 3/10 hectares which he operates "on own account" and which includes his house and garden; the other is a 78-hectare holding of which he is the hired manager. The latter holding is located outside this PSU but is included in the sample frame for this PSU.

We have thus provided a way to associate every piece of agricultural land with one and only one holding, and every holding with one and only one chance to be included in the sample. Column 6 of the listing page provides a list of all holders, and column 7 (sublines that are checked) provides a list of all holdings.

2.3 *Out-of-scope holdings*

The holdings of less than 1/10 hectare are excluded from the scope of the Agriculture Census unless they qualify as National Certainty (NC) holdings because of specialized agricultural operations (see section 2.1 in chapter 2 of Unit IV). It is assumed that many of these very small holdings have only vegetable gardens or animals for home consumption. The Listing Book provides for listing and identifying these holdings (column 8). Thus, a count of them is obtained in the sample PSU's and an estimate of their total number can be made.

2.4 *Listing problems*

Listing all the housing units in a relatively small geographic area may sound like an easy task. Actually it can be a complex undertaking. The enumerator must visit each housing unit in the PSU, determine the number of holdings associated with it, and complete the listing for each holding.

In making the listing, he should be aware of the most common causes of duplications and omissions.

To avoid duplications, the enumerator must be alert for cases of multiple holders of single holdings; partnerships will be the most common example of this in the Provinces. The enumerator must also be able to determine when two or more agricultural operations comprise more than one holding and when they all belong to the same holding.

Probably the most common cause of omissions in the listing results from the enumerator missing isolated housing units in his canvass of the PSU. Another important cause of omissions is the tendency of an enumerator to list one holding at a housing unit and then to forget to ask about additional household members who have holdings which should be listed separately.

The best protection against duplication and omissions is a carefully planned listing procedure.

3. PREPARING THE SAMPLING FRAME

The enumerator, in filling columns 8 to 12 of the Listing Book, will provide the information needed for identifying the small, out-of-scope holdings, and for stratifying the remaining holdings into four size groups. Any holding which has an entry in column 9, 10, 11, or 12 of the Listing Book is a possible unit in the final sampling frame. However, one more adjustment must be made by the supervisor before the sampling frame is ready. He must determine whether the listing units in columns 9 through 12 include any National Certainty holdings. National Certainty holdings have already been listed in another sampling frame and must be eliminated from the list of holdings within the sample PSU. The supervisor, just before he selects the sample holdings in a PSU, will use a wavy line to mark out the entries in columns 8 through 12 for National Certainty holdings. All other holdings with an entry in one of these columns will comprise the final sampling frame for the PSU. (All the National Certainty holdings will be assigned to enumerators from the National Certainty Listing, Form A-2c (see exhibit IV-3-2).

4. SELECTING THE SAMPLE HOLDINGS

The sample holdings will be selected by the supervisor during his first visit to the enumerator after the listing for a PSU has been completed. It might seem strange that after completing a complex job like the listing operation, the enumerator is not permitted to select the sample himself. There are two major reasons for requiring the supervisor to make the selection. First, survey experience shows that, when the enumerator makes the selection, he is likely to include a larger-than-expected proportion of certain types of units which he has some reason for preferring to enumerate. This, of course, results in a biased sample; the procedure will be avoided in Agrostan. Secondly, it is advisable to have some control over the supervisor's activities. Requiring him to visit the enumerator to select the sample is some assurance that each enumerator's work will be given at least a minimum review before the sample is selected. After his review, the supervisor will select a sample from the PSU; this sample will include all Local Certainty holdings and one-fourth of the small holdings.

4.1 Local Certainty holdings

The definition of a Local Certainty holding is based on size of holding and will vary by Province. In Liberto, Lopez, Morgan, and Tali Provinces all holdings in sample PSU's with 50 hectares or more and which are not National Certainty holdings, will be Local Certainty holdings. The size limitation is 100 hectares in Bolivar, Dubois, Hassam, Lo-San-Tho, and Paris Provinces and is 200 hectares in Dewar, Rajpur, Rama, and Valencia Provinces.

The reason why the definition of Local Certainty holdings varies is that agriculture is more intensive in some Provinces than in others.

Thus, in Lopez Province where the soil is fertile and the rainfall is plentiful a holding of 50 hectares contributes heavily to agricultural production. In contrast, a holding of 50 hectares is not especially important in Rajpur Province with its arid climate and infertile soil. The objective of the procedure for Local Certainty holdings is to identify the more important holdings which are not on the National Certainty List and to sample these holdings at a higher rate than the small holdings.

Since Ranchi District is in a Province (Rajpur) where the size limitation for Local Certainty holdings is 200 hectares, all of the holdings in the PSU with an entry in column 12 (200 or more hectares) will be in the sample with certainty. In general, about one-fourth of all the Local Certainty holdings will be in the sample in every district, since a fourth of the PSU's are in the sample.

4.2 *Small holdings*

From the small holdings which remain in the sampling frame, one-fourth will be selected systematically in each sample PSU. The supervisor will be provided with sampling instructions which include two numbers, one to identify the first sample holding in the smallest size category (the "start with" number), and another for the sampling interval (the "take every" number). The sample is then selected systematically from each size category in the Listing Book for the PSU.

In the Provinces of Agrostan, the "take every" number is always 4 and the "start with" number is always a number between 1 and 4 inclusive. Let us suppose that the "start with" was 4 so that we can apply the sampling instructions to exhibit IV-4-1. Then in column 9 of exhibit IV-4-1, the first sample holding is the fourth listed holding. Then the 8th holding, the 12th holding, etc., from column 9 are selected until the last holding listed in column 9 (on the last page of the Listing Book) has been counted. The remainder of the interval is carried into the next size category in column 10 (on the first page of the Listing Book), and finally the process is continued through column 11. (The holdings listed in column 12 will all be Local Certainty holdings in Rajpur Province.)

The result of the sampling process is the 1 in 4 stratified sample of small holdings in the PSU, the sample cases identified by the circled entries in columns 9 to 11 on the listing pages (see exhibit IV-4-1). All Local Certainty holdings will also be circled for enumeration. In some Provinces, the sampling may end with column 9 or 10, depending on the definition of Local Certainty holdings in the Province.

The enumerator will be instructed to return to each of the sample small holdings and to each Local Certainty holding to conduct an interview to obtain information for the Agriculture Questionnaire.

4.3 *PSU's with a very large number of small holdings*

In spite of the steps taken to approximately equalize the PSU's in terms of number of holdings, there will probably be some PSU's that vary widely from the desired number of about 80. In most cases this will simply result in a variable workload of listing and interviewing. However, in the possible case that the number of eligible small holdings in the sampling frame is more than double the expected number, another procedure will be used to avoid having the interviewer spend an excessive amount of time in one PSU.

In such a case, the supervisor will select the sample of small holdings at a rate of one-half (or at the least, one-third) of the usual rate. After preparing the sampling frame as described above, he will enter the counts of holdings on the cover of the Listing Book. By adding appropriate columns of line j ("Eligible for PSU sample"), he will find the total number of small holdings in the frame. If this number is over 160, the usual 1 in 4 subsampling rate would produce a sample of over 40 small holdings. Instead, he will use a rate of half the usual rate or 1 in 8. In the unlikely event that the number is over 240, he will use one-third of the usual rate or 1 in 12. He should always record such unusual subsampling rates in the "Notes" space on the Listing Book cover (for example, "1/2 sample of small holdings").

Chapter IV - 5. SAMPLING IN THE NORTHERN TERRITORY

1. *INTRODUCTION*

The sampling procedures which will be used in the Northern Territory are slightly different from those used in the Provinces. These procedures and the conditions in the Territory which require them, are discussed in this chapter.

The Northern Territory is largely undeveloped and consists of three zones (the Atbara River Basin, the Northwest, and the Subic Mountains). The population of the Territory is basically a subsistence-farming population. In one of the zones, the Northwest, there are a few nomadic tribes which raise sheep, goats, and cattle for their livelihood. Most of the population lives in tribal chiefdoms, although the tribal structure is beginning to break down.

The climate is essentially arid. Most of the field crops which require much moisture are produced along the Atbara River, where some irrigation is practiced. The rest of the Territory produces mostly livestock or crops which will grow under relatively dry conditions. Because of the higher per-holding cost to take a census in the Territory and because it was felt that the predominantly subsistence-type agriculture had little effect on the total production of Agrostan, the Northern Territory was not covered in the 1961 Sample Census of Agriculture. The materials used for planning the 1971 Sample Census of Agriculture in the Territory will come from the 1970 Population Census and other sources.

2. *CENSUS OBJECTIVES AND PROBLEMS*

Since agricultural development planning is of a more general nature in the Territory, the requirements for detailed agricultural data are not as great as for the Provinces. On the other hand, some special problems exist in the Northern Territory which make it necessary to modify the procedures adopted for the Provinces.

2.1 *Census objectives*

In terms of data requirements, fewer items will be covered and fewer estimates by subgroups will be published. The required level of reliability of the census estimates will also be lower in the Northern Territory than in the Provinces.

2.11 Estimates for zones.--In the Provinces, data will be produced for each district; estimates by district will be combined into estimates for individual Provinces and for the 13 Provinces as a whole. In the Northern Territory, on the other hand, it was determined that data would not be required by district or any other small administrative area. Instead, data would be required at the zone level. The sampling plan, therefore, provides that estimates can be made for each of the three zones and for the Territory as a whole. It was decided that resources which would normally be used to provide estimates for smaller areas could better be spent either in improving data for the Provinces or in improving the zone estimates for the more important characteristics.

2.12 Estimates for subgroups.--There will be fewer subgroups requiring separate estimates in the Territory than in the Provinces. This reduction will result mainly from limiting the number of cross-classifications in the tabulation plans. Therefore, estimates will be made for most of the broad classes of data, but much less detailed information will be produced.

2.13 Accuracy of the estimates.--Since the census data for the Northern Territory will be used to make broad decisions, the accuracy of the estimates for each of the zones need not be as great as for the average district in the Provinces. It is believed an error level[1] of 10% can be tolerated for characteristics associated with half of all the holdings, and that decisions based on these estimates will still be valid. It was decided, however, that this error level should apply to such characteristics in the smallest zone; corresponding errors in the larger zones will be smaller. For characteristics associated with fewer than half of all holdings in a zone, a larger error in the estimate will be tolerated. Characteristics associated with more than half the holdings will have smaller errors, as will estimates for the Territory as a whole.

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[1] "Errors" as discussed in this section refer to the coefficient of variation of the estimates. They should be doubled to obtain the error limits for the 95% confidence level.

2.2 Census problems

In addition to having different objectives in the Northern Territory, the problems of census taking are much greater there than in the Provinces. These problems will affect the procedures which can be used in carrying out such a large operation.

2.21 Mapping.--The lack of suitable maps for census work is perhaps the greatest problem of all. The more detailed maps required for census work are not available, although there are large-scale maps of the whole Territory. For the 1970 Population Census, enumerator assignments were made up largely from a list of chiefdoms; population living on land not associated with a chiefdom was enumerated in Special EA's (special enumeration areas). The boundaries of chiefdoms usually were not accurately shown on maps and were not clearly visible in the field. It is believed that many of the Special EA's were not canvassed as thoroughly as the chiefdoms and a large proportion of the population in such areas might have been missed. The 1970 Population Census enumerators were required to make a rough sketch of the Special EA's. However, there were no enumerator maps prepared for the chiefdoms, since each tribal group was able to identify which population made up its chiefdom.

The agricultural census enumerator's assignment will generally consist of two or three chiefdoms or Special EA's. An effort will be made during the census preparations to compile an accurate list of all the chiefdoms and Special EA's from the 1970 Census of Population results. This list will serve as the frame of primary sampling units covering the Territory. After the sample PSU's are selected, crude maps will be prepared on which the field supervisor will mark the name and approximate location of the sample chiefdom. The enumerator will be given one of these maps to help him find the selected chiefdoms. For the Special EA's in the sample, he will be given a copy of the sketch prepared by the 1970 Population Census enumerator.

2.22 Response error.--The responses by the holders in the Northern Territory may sometimes be in error. Because of their isolation, they do not think in terms of area or volume in standard units. Therefore, the enumerator will generally not be able to obtain acceptable information from the respondent on the area under cultivation or the amount of production. Instead, data on area of the smaller holdings will be obtained by measuring a subsample of such holdings, and production data will be obtained only for five major crops.

It is expected that often the respondent will be highly suspicious of the interviewer, thinking of him as a government tax collector or other official seeking individual information which might be used to the respondent's disadvantage. Therefore, many respondents may hesitate to give information or may even give some false information.

2.23 Polygamy.--The practice of polygamy still exists in the Northern Territory. This presents many problems in listing the holdings since the wives in most cases would be considered separate holders. The relationship of one wife to another is not always clear, however, and the enumerator may have difficulty deciding whether the wives have separate holdings. Normally, the wives live in different households; occasionally, they live in different chiefdoms. Those who live in different chiefdoms will not present many problems since their agricultural activities are almost always independent of each other. When the wives live in the same chiefdom and have independent holdings, the enumerator must make sure that each holding is listed separately.

Often two or more wives who live in the same chiefdom will grow their crops on the same plot of land, with each contributing part of the labor, seed, fertilizer, etc. It may be difficult to separate the activities of one wife from another; and in a sense the holding is a partnership. The holding of the senior (first-married) wife would be listed as a partnership holding; and if selected for the sample, an Agriculture Questionnaire would be completed. The holding would also be listed when the household of a junior wife is listed; but if selected in the sample, an Agriculture Questionnaire would not be completed. (See question 3 of the Agriculture Questionnaire for the Northern Territory, exhibit III-2-3.)

One of the problems which affects the agriculture census is that the husband cannot easily be associated with a single holding, since he generally divides his time among the several households. The husband usually has agricultural operations of his own, such as cattle or other livestock, and these cannot always be associated with a single housing unit in the listing process. In Agrostan, the husband will be included in the sample at the household of only his senior wife. His cattle, other livestock, or other independent agricultural activities would then be included with those of the wife with whom he is listed.

2.24 Between-PSU travel.--The chiefdoms of the Northern Territory are not usually located along main roads or other thoroughfares which can be traveled by automobiles. Normally, the interviewer must ride a bicycle or walk long distances from the road in order to reach his assigned chiefdom. Therefore, only two or three sample PSU's can be assigned to an enumerator. Many chiefdoms will be located in isolated spots in rugged mountainous terrain, or in other fairly inaccessible places. Such locations will make supervision very difficult.

2.25 Cultivation practices.--The cultivation practices of the holders in the Northern Territory will also cause some problems. The holdings are normally quite small in size and irregular in shape. Since most holders will not be able to provide information about the area cultivated, objective measurement of the crop area will be carried out.[2] Such measurements for an individual holding will probably not be entirely accurate, especially when the holding is irregular in shape.

As in the Provinces, there is the practice of interplanting, where two or more crops are grown together. For example, peas, peanuts or beans are often grown together with maize. A second crop is normally grown along with coffee. There will also be examples of succession crops where one crop is produced and harvested and another is planted and harvested on the same land in the same year. Such cultivation practices require special census concepts, definitions, and procedures (see Unit III of the case study).

3. *SAMPLE DESIGN*

The sample design for the Northern Territory will take account of the special objectives and problems of this area. Included will be a description of the sample design for objective measurement of the crop area for a subsample of holdings.

3.1 Considerations affecting the sample design

Several considerations affect the sample design. Among them are the definition and size of the universe, the definition and size of PSU's, and the total sample size needed.

3.11 Definition of the universe and estimated total number of holdings.--The universe, or population of units about which agricultural information will be obtained, consists of all agricultural holdings with one exception: those located in the built-up portion of the capital city of Zanzi.

As in the Provinces, the preliminary population counts from the 1970 Population Census provide a basis for estimating the number of holdings in the universe. These counts are shown in exhibits IV-5-1, IV-5-2, and IV-5-3. After eliminating the PSU's and the estimated population in the built-up sections of the capital city and classifying the remaining population by size and kind of PSU (urban or rural) in which it is located, results shown in the first three columns of exhibit IV-5-4 are obtained. From these data and certain assumptions described in the footnotes of that exhibit, the following rough estimates of the universe numbers of holdings in each of the three zones were made:

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[2] Objective measurement will be applied only to the small holdings. It is assumed that operators of large holdings will be able to respond directly to the questions on land area.

Zone	Holdings (estimated)
Total................	70,000
Atbara River Basin.........	29,000
Northwest..................	24,000
Subic Mountains............	17,000

It was expected in the early stage of planning that there would be about 100 very large holdings to be classed as National Certainty holdings, and thus included in the census with certainty. It was decided not to attempt a special sampling of Local Certainty holdings in the Northern Territory.

3.12 Definition of PSU's and estimated numbers by population size.--As mentioned earlier, PSU's will consist of chiefdoms or Special EA's as used for enumerator assignments in the 1970 Population Census. The estimated numbers of PSU's (chiefdoms plus Special EA's) for each of the zones are as follows:

Zone	Estimated PSU's
Total................	1,969
Atbara River Basin.........	821
Northwest..................	677
Subic Mountains............	471

3.13 Estimated total sample size needed.--The total sample size needed was determined by the reliability requirement for the smallest zone (the Subic Mountains), plus the fact that a constant overall sampling rate for small holdings in all zones was desired. Following the same reasoning as in the Provinces, a sample of about 400 small holdings in the Subic Mountains would produce estimates with about the same reliability for small holdings. With fewer certainty holdings in the smallest zone of the Northern Territory than in the average district of the Provinces, the reliability of estimates for all holdings will be less in the smallest zone than in the average district. However, the accuracy requirement is also less exacting, since coefficients of variation of 10% for most items are acceptable. It was decided that a 1-in-48 overall sampling rate of small holdings would be sufficient for the Subic Mountains, where it would produce a sample of about 350 small holdings. This rate was also specified for the other two zones, where it will be more than sufficient -- that is, it will produce results with an accuracy level above the specified minimum.

3.2 *Basic two-stage sample plan*

For the same reasons of economy as prevailed in the Provinces, a two-stage plan was adopted for small holdings, with supplementation by the approximately 100 National Certainty holdings. However, since it was not feasible to equalize the size of PSU's, variable sampling rates by size of PSU were adopted at the two stages, with a constant overall sampling rate for small holdings. This plan helps to control sampling error and to equalize the interviewing workload within PSU's. It was decided that the average number of small holdings within selected PSU's should be somewhat smaller than the number 20 used in the districts, because of the larger amount of work to be done, considering the area measurements. Therefore, the number 15 was chosen as the desirable size of sample of small holdings within the average PSU in the Northern Territory.

PSU's were classified into five tentatively defined population size groups, as shown in the table on the following page. The table also shows the expected average population and the expected average number of holdings in each size category.

Category	Population size group	Average population	Average number of holdings (estimated)
I	Less than 300	160	30
II	300 to 599	400	70
III	600 to 999	700	130
IV	1,000 to 3,499	1,400	250
V	3,500 and over	3,700	700

After some trial-and-error experimentation, it was found that the following rates, having convenient intervals, would give approximately the desired number of sample small holdings on the average:

Category	Sampling rate		
	For PSU's	Within-PSU	Overall
I	1 in 24	1 in 2	1 in 48
II	1 in 12	1 in 4	1 in 48
III	1 in 6	1 in 8	1 in 48
IV	1 in 3	1 in 16	1 in 48
V	1 in 1	1 in 48	1 in 48

The principle used in setting the tentative limits of the population size groups was that we wish to have a small frequency in the largest population size groups in order to reduce the task of listing these large PSU's. The other class limits and sampling rates were determined very roughly by the requirement of keeping the within-PSU sample around 15. For example, with a 1-in-2 rate, we need a PSU of average population size of 160 (or an average of 30 holdings) to get a sample of 15 holdings. The PSU's of less than 300 population have about 160 persons on the average.

Later it was necessary to modify these limits to those shown in exhibit IV-5-4. The final limits vary in the different zones; they were set where they would give frequencies in the larger population size groups, equal to or simple multiples of the interval for sampling PSU's. For example, by changing the lower limit of group IV in the Atbara River Basin from 1,000 to 1,500, we obtain a frequency of 3 PSU's in the group (1,500 to 3,499 population), which facilitates selection of 1 in 3 PSU's.

This sample plan will produce a total sample distributed as follows among the three zones (see also exhibit IV-5-4).

Zone	Sample PSU's	Small holdings in sample	National Certainty holdings
Total......	101	1,460	105
Atbara River Basin...........	44	610	60
Northwest........	33	495	30
Subic Mountains..	24	355	15

3.3 *Three-stage sample for area measurements*

Area measurements will be made in a systematically selected one-fourth of all sample small holdings in the Northern Territory. It is assumed that area data can be obtained directly from the respondent for National Certainty holdings.

3.4 *National Certainty holdings*

The list of about 100 National Certainty holdings will be compiled by the district marshals following procedures similar to those used in the Provinces. The list will thus include large holdings located anywhere in the Northern Territory, and not limited to sample PSU's. Questionnaires will not be sent by mail to NC holdings, as was done in the Provinces.

4. *SELECTING THE SAMPLE OF SMALL HOLDINGS*

The steps required to carry out the selection of the sample according to the above general plan include:

(1) Listing and stratifying PSU's
(2) Selecting the first-stage units (PSU's)
(3) Listing and stratifying holdings
(4) Selecting the second-stage units (small holdings)
(5) Selecting the subsample of small holdings.

4.1 *Listing and stratifying PSU's*

The first-stage sampling frame for the Northern Territory is a list of all the chiefdoms and Special EA's (government stations, missions, mining camps, fishing and trading centers). The list resulting from the 1970 Population Census for the Northern Territory will be the basis for the agriculture census sample. The lists for the Population Census were derived from various administrative lists in the Territory plus additional chiefdoms found by the Population Census supervisors which were not included in any administrative record.

The most up-to-date list of chiefdoms is likely to be the one maintained by the tax authorities. However, the Agrostan Government sponsors a number of activities for the Territory. Several agencies carry out work even in the very isolated areas, and all have lists of chiefdoms and special areas under their jurisdiction. These lists should be compared with the Population Census list. Any chiefdom or special area not on the latter list should be added to it.

Perhaps the greatest improvement in the sampling frame can be made by the Agriculture Census supervisors in their preparatory work for the census. The supervisors will be hired a few weeks early and will be required to canvass the area assigned to them, to plot the location of the sample chiefdoms and Special EA's on topographical maps or sketches, and to spot the National Certainty holdings on the map. Only after using all reasonable sources of information, including the canvass by the census supervisors, should the list of chiefdoms be considered acceptable as a sampling frame.

The stratification within the zones of the Northern Territory will be carried out in a manner similar to that in the Provinces, using PSU cards. However, the cards will first be sorted into the population size categories described above (see exhibits IV-5-1, IV-5-2, and IV-5-3). In sorting, the original geographic order should be maintained within categories.

The precise population of some of the chiefdoms might not be known. If so, a judgment should be made of the proper size category. If some PSU's are incorrectly classified by size, the effect on the reliability of the sample will not be very serious unless it happens often.[3] Within each size category, the PSU's should be ordered in geographic sequence or possibly by using additional criteria such as those used in the Provinces. It may be noted that this stratification process is different from that used in the Provinces. The latter did not require the formation of definite strata or groups; the PSU's were simply placed in a list with similar PSU's listed near each other. The use of strata consisting of definite groups in the Northern Territory is necessary because the PSU's are chiefdoms and Special EA's of highly variable sizes and they will be sampled at variable rates. As mentioned in the description of the basic sample plan, the holdings within these groups will also be sampled at variable rates so that the overall sampling rate will be constant. Since the Northern Territory will have no Local Certainty holdings, the PSU's can be selected at the variable rates without increasing the number of weights required to make estimates.

4.2 Selecting the PSU's

The five different size categories for the PSU's of the Northern Territory and the sampling rates are given below. A systematic sample will be selected, using a different random start in each category, but continuing from zone to zone within a category. A worksheet should be prepared similar to the one used in the selection of the sample PSU's in the Provinces (refer to exhibit IV-3-8 omitting columns 5 and 6).

Category	Sampling rate for PSU's
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[3] An alternative way of classifying the chiefdoms would be to have four descriptive groups, such as small, medium, large, and very large. The gains from this type of stratification should be nearly equal to those gains from stratification with known population sizes.

4.3 *Listing and stratifying holdings*

As in the Provinces, the small holdings within the sample PSU's in the Northern Territory will be listed and stratified; however, the criteria for stratification and the sampling procedure will be different. See exhibit IV-5-6 (illustration of a filled Listing Book for a sample PSU in the Northern Territory) and exhibit IV-5-5 (sketch of the location of the housing units in the PSU).

Special care must be taken in the listing of holdings within sample PSU's in the Territory. Chiefdom boundaries are not well defined and housing units which appear to be just outside the boundaries might in fact belong to the chiefdom. In addition, some social customs of the Territory complicate the identification of holdings. Nomads may also present difficulties. They will be sampled where their housing units are located at the time of enumeration.

One major difference in listing in the Territory as compared with the Provinces is reflected on the listing sheet (exhibit IV-5-6) for the Territory. The size categories which were used to stratify the holdings in the Provinces have been omitted from the listing sheet of the Territory because the holders are not expected to be able to provide information on size. Instead, information is obtained on number of livestock--a figure which the respondents can usually provide. Numbers of cattle, sheep and goats are recorded in columns 8 and 9, the holdings are stratified by whether or not they have more than specified numbers of livestock, and the sample holdings are selected separately from these categories.

The definition of holding and the selection process are also slightly different in the Northern Territory where there is no minimum size of holding and there are no Local Certainty holdings.

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The sample of holdings in the Territory will be selected by the enumerator rather than by the supervisor (see section 5 below). The enumerator will visit all housing units in a PSU, list the holdings associated with each housing unit, record the number of cattle, sheep and goats on each holding in columns 8 and 9 of the listing sheet, and separate the holdings with large numbers of livestock from those with small numbers by filling columns 11 and 12.

To select the sample, the enumerator will be provided with two numbers--a "start with" and a "take every" number, shown for "PSU sampling" in item (a) on the cover of the Listing Book (see exhibit IV-5-6). Both of these numbers might vary from PSU to PSU. The enumerator will count the holdings with large numbers of livestock ("X" in column 11) until he reaches his "start with" number, which will be the first sample holding. Then the sample interval, or "take every" number, is added repeatedly to identify succeeding sample holdings of this type shown in column 11. When the end of this category is reached, the sampling continues to the other category ("X" in column 12) until that category has been sampled.

4.5 *Selecting the subsample for area measurement*

After selecting the holdings, the enumerator will select the subsample of holdings for area measurement. The original sample holdings will be shown by the questionnaire numbers assigned to them in columns 14 and 15 of the Listing Book. The subsample of holdings is selected by taking one of the first four sample holdings randomly and then selecting every fourth sample holding thereafter. Instructions for making the selection will be given for "area measurement sampling" in item (a) on the cover of the Listing Book for each PSU.

5. *ENUMERATION PLAN*

As was indicated above, conditions in the Territory are such that the enumeration plan used for the Provinces requires substantial modification for use in the Northern Territory.

5.1 Interviewing and supervision

There will be 8 or 9 supervisors, each in charge of 4 or 5 enumerators. Due to the unfavorable travel conditions, the supervisor will be unable to plan the time of his visits to the enumerator so that he can select the sample as in the Provinces. There could be serious delays in completing the field work if the enumerators were required to wait until the supervisor was available to select the sample holdings. The supervisor will review the sample selection in every PSU, however, and will reselect the sample in those cases where the proper sampling procedures were not followed.

The enumerator will be assigned a single PSU (chiefdom or Special EA) at a time. He will visit his sample area, list the holdings, and select the sample holdings, using the sampling instructions for his PSU. The supervisor will visit the enumerator as often as possible but, because of travel difficulties, he may not always be able to follow a predetermined schedule. Since PSU's will not be made of equal size as in the Provinces, the time needed for listing will vary greatly for the PSU's in the Northern Territory. The sample design tends to equalize the interviewing workload but not the listing workload.

The National Certainty holdings will be interviewed generally by the enumerator closest to the holding. Because of poor communication systems, the questionnaires will not be mailed to the holders as in the Provinces. For the area of cropland, the information will be obtained by a direct question, since it is assumed that holders of large tracts of land would be able to supply such information (objective measurement will not be applied to the National Certainty holdings).

Since the enumeration plan requires the enumerator to work independently, a careful review of the enumerator's work by the supervisor is most important. If the review indicates that the enumerator is doing good work, a second PSU or several National Certainty holdings may be assigned to him.

5.2 Objective measurement of area

Objective measurement of the crop area in the holding will be carried out at a randomly selected one-fourth of the sample small holdings in the Northern Territory. In order that the measurements can be done quickly and with reasonable accuracy, a simple method of making the measurements is needed.

5.21 Making the sketch of cropland in the holding.--The greatest difficulty in measuring an area objectively is in preparing an accurate sketch of the land. After a sketch is made, the number of hectares (or other unit) can be determined in several ways.

In the Territory, the holding will often be divided into many plots of irregular shapes. Each of the plots must be sketched separately and the crop areas clearly outlined and labelled to permit identification of the five important crops separately (wheat, rice, cotton, coffee, and sisal). The sketch will be made on the graph portion of page 4 of the Agriculture Questionnaire for the Northern Territory. The graph is divided into equal-sized squares--representing 20 meters on each side; each square contains 16 dots to guide in determining fractional parts of a square. The only equipment needed will be a reasonably accurate compass, measuring chain, and a dozen or more marking poles. The poles should be red or some other highly visible color, although some of the enumerators will find it necessary to cut poles from nearby bush.

The enumerator will begin the measurement at one corner of the sample holding. Using the compass, chain, and measuring poles, he will fit a rectangle to include as much of the crop area as possible and sketch the rectangle onto the paper. With the sides of the rectangle as a base line, he will sketch the boundaries of the area by measuring the distance between the base line and the boundary at intervals of 20 meters and marking the measured points on the sketch. The points, so marked off on the sketch will be joined with straight lines which will approximate the area boundaries. The Enumerator's Reference Manual (Northern Territory), Form A-51, explains the area measurement technique in greater detail.

When the crop area consists of separate plots, the enumerator should measure and sketch each plot separately.

5.22 Determining the area.--The actual computation of the area will be done by the staff in the Central Office of the NSO. The number of complete squares within the boundaries will be counted and multiplied by the known area represented by each square. For squares which are only partially inside the boundaries, the area will be determined by estimating the proportion of dots inside the boundaries, multiplying the proportion by the known area of the square, summing over all partial squares and adding it to the area included in whole squares. The procedure will be followed for all plots in the holding. Finally, the area of the plots will be added together for the total crop area of the holding.

If the squares of the rectangle are of a suitable size, the method could be used to make estimates of yield. A sample of the squares from each crop could be selected and staked out early in the growing season for measurement at harvest time. Yield estimates could then be made for the Territory or for the zones, but not for individual holdings. Estimation of yields is not recommended as a census activity, however, due to the heavy costs of making several visits to the plot during the year. Data on yields should preferably be collected in the annual agriculture statistics program.

6. *PREPARATION OF ESTIMATES*

Estimates in the Northern Territory will be made--after adjusting for non-interviews--by weighting the sample results for the small holdings by 48 and adding the results for the National Certainty holdings. The area in cropland, which will be measured for a fourth of the small holdings, will be obtained by weighting the appropriate entries from the subsample by 192 and adding the corresponding entries for the National Certainty holdings. The estimation method is described in chapter 6 of this unit. The first-stage ratio adjustment described in that chapter may also be used in the Northern Territory.

Census objectives for characteristics involving area will be quite limited. The distribution of the holdings by size of crop area can be obtained for each of the zones. Any cross-classification of size data with tenure or other characteristics should be avoided at the zone level. However, such data should be of sufficient reliability for the Territory as a whole if the number of cross-classifications is held to a minimum.

Variance estimates can be made using the procedures described in chapter 7 of this unit.

7. *SUMMARY*

Estimates for each of the three zones in the Northern Territory are required. The sample for the Territory was designed so that most estimates could be made with no more than about a 10% coefficient of variation. The sample holdings will be selected from sample PSU's (chiefdoms and Special EA's). The PSU's will be selected with different probabilities depending on their population. Holdings will also be selected at variable rates so that the overall sampling rate is the same for every holding except the National Certainty holdings. A total of about 1,500 small holdings and about 100 National Certainty holdings will be selected in the sample. There will be no Local Certainty holdings.

Objective measurement of the area of cropland in the holding will be carried out for a subsample (one-fourth) of the small holdings. Area in cropland will be reported for all the National Certainty holdings, but will not be measured objectively.

Exhibit IV-5-4 summarizes the sample size for the Northern Territory.

Chapter IV - 6. ESTIMATES OF CHARACTERISTICS FROM THE SAMPLE

1. *INTRODUCTION*

When the enumeration and area measurements have been completed, and all the questionnaires checked in and edited, there will be some sample holdings for which no usable questionnaires were obtained. This chapter describes a method of adjusting the sample for such "noninterviews" and for questionnaires with missing area measurements. The noninterview adjustment does not apply to individual missing or inconsistent entries in the questionnaire, which in some cases are corrected by editing or imputation (supplying the data according to prescribed rules) and in other cases are allowed to appear in a "Not reported" category.

This chapter also describes a simple method of expanding the adjusted sample results to obtain estimates for the entire universe of holdings. Since three probabilities of selection were used in the Provinces, there are three expansion factors (or weights) to be used in making estimates for the districts and the Provinces. Similarly, there are three weights for the Northern Territory.

2. *NONINTERVIEW ADJUSTMENT*

In an agriculture census, it is practically impossible to obtain interviews from every holding which is specified for enumeration. Unless corrected for, the noninterviewed cases could cause a serious bias, especially in estimates of totals and aggregates. If the number of all such cases is not more than about 5% (10% at the very most), a simple noninterview adjustment may give satisfactory results.

2.1 Types of noninterviews

A holding may be a "noninterview" for a number of reasons. The noninterview adjustment is limited to those holdings for which Agriculture Questionnaires would have been filled if a completed interview had been obtained. These are cases which are reported as:

(1) No one at home at time of call

(2) Temporarily absent for a period of time

(3) Refusal

(4) No qualified respondents available.

There may also be a few cases where the questionnaire is lost, destroyed, or so poorly filled in that it is not usable. These are also treated as noninterviews if it is determined that a return visit would be impractical.

2.2 Adjustment for noninterviewed small holdings

To adjust for noninterviews of sample small holdings, data for an interviewed small holding in the same PSU and preferably in the same size-of-holding group (as shown in the Listing Book) will be substituted for the noninterviewed holding. Suppose, for example, the fourth sampled holding shown in exhibit IV-4-1 is reported as a noninterview because there was no one at home. We select the next sample holding in the same size category (the 13th sample holding in exhibit IV-4-1) and duplicate it, either by making up an identical questionnaire or by duplicating the corresponding cards for that holding. This has the effect of doubling the weight for the holding which is duplicated. If a computer is used, the duplication of questionnaires or cards is unnecessary; the procedure will be to simply double the weight of the interviewed questionnaire. If there are two noninterviews in the same PSU, a second holding (other than the one already duplicated) is selected in a similar way, and this holding is duplicated.

A slight variation in this procedure for small holdings is necessary in the Northern Territory, where every fourth sample small holding is specified for area measurements. To keep the area measurement sample self-weighted, a noninterview among the holdings specified for area measurements will require duplication of another holding having area measurements. Similarly, for holdings not requiring area measurements, interviewed holdings without area measurements should be substituted for noninterviewed cases.

2.3 *Adjustment for noninterviewed certainty holdings*

As described earlier, a greater effort will be made to obtain census data from Local Certainty holdings, and especially from National Certainty holdings. No doubt there will be some noninterviews remaining in both categories.

For Local Certainty holdings the noninterview adjustment will be made in the same way as for small holdings--by duplicating another Local Certainty holding in the same size group. Where possible the substitute holding will be in the same PSU, but it may be necessary to use an interviewed Local Certainty holding from another PSU in the same district. In either case, the selection should be made according to a predetermined procedure, such as taking the next numbered Local Certainty holding in the same PSU or, where necessary, in the next numbered PSU.

For National Certainty holdings, we can expect that there will be very few interviews available for duplication in the same PSU or even within the same district. The interviewed National Certainty holdings may also be very different from those missed. Therefore, duplication will usually not be feasible. Instead, data for the questionnaire will be imputed on the basis of the best available data.

3. *ADJUSTMENT FOR MISSING AREA MEASUREMENTS*

In some cases in the Northern Territory, the interview portion of a questionnaire will be usable but the area measurement information will be missing or not usable. These will be treated the same as other cases of individual missing or not usable entries. The area measurement data will be imputed on the basis of the best information available, and the imputed entries should be consistent with production data for the corresponding crops in Section IV of the same questionnaire.

4. *IDENTIFICATION OF DUPLICATE CARDS*

Duplicate cards will be punched, or double weights assigned, primarily for noninterviews. Another possible reason is to compensate for unusual subsampling rates used for small holdings in PSU's having a very large number of small holdings. This would require duplicating, or at most triplicating, all the small holdings in a PSU, since subsampling rates in those cases are either 1/2 or 1/3 of the usual rate. (See section 4.3 in chapter 4 of Unit IV.) Replication eliminates the need for additional weight groups in these cases.

When a card is duplicated (or a weight is doubled), a code should be punched in the duplicate card to show that it is a duplicate and to indicate the reason for the duplication. Such a code will enable the NSO staff to analyze the effect of the duplications on the census results.

Sometimes a different color is used for duplicated cards (or cards with a doubled weight) for easy visual identification in the deck. A code punched in the card is still necessary, however, in order to sort the duplicated cards from the main deck.

5. *ALTERNATIVE ADJUSTMENT PROCEDURES*

The procedure outlined for handling noninterviews was considered to be the most practical for Agrostan, and the simplest to carry out. Another method of substitution is to select the holding to be duplicated at random, from those interviewed in the same size group in the PSU. Any reasonable method of substitution may be used if it is predetermined and the number of cases is not very large. If the noninterview rate is large, no method of substitution can be very satisfactory.

A second alternative is to increase the weight of all the "interviewed" questionnaires in the PSU where the noninterview occurs; the weight would be increased to the extent needed to offset the noninterviews in the PSU. In effect, this procedure substitutes average characteristics for the missing data, which is theoretically more desirable than multiplying some cards in the PSU by 2 and not multiplying others. On the other hand, the procedure of changing the weight would result in many different numbers for the weights, and would complicate the tabulations; it is usually not feasible unless a computer is available for processing the data.

6. *POSSIBLE BIASES IN ADJUSTMENT PROCEDURES*

Duplication of questionnaires or cards to adjust for noninterviews will lead to a sample set of questionnaires or cards for the same number of holdings as if usable interviews were obtained from all sample holdings. However, some serious problems may still arise because of the noninterviews.

(1) The noninterviews may be concentrated in certain subgroups of the population, such as holdings belonging to holders who are either very young or elderly. For such a group, we may be representing these holdings by others which have rather different characteristics.

(2) If the noninterview rate (including lost questionnaires) becomes more than about 5%, efforts should be made to reduce it by retraining enumerators and requiring more call-backs.

7. *ESTIMATES FROM THE SAMPLE*

In planning for a census or survey, table formats are prepared in advance showing the kinds of estimates to be made. (Tables for most of the estimates which will be made for Agrostan have been prepared and are given in the appendix of Unit III.) After the cards have been edited, coded, and duplicated for noninterviews, they are tabulated and weighted to provide the data for the cells shown in the table formats. From the table formats for Agrostan, it can be seen that the required estimates are of the following types:

(1) Estimates of numbers of holdings and of aggregates

(2) Estimates of ratios, percentages, and averages; and estimates of proportions of holdings having an attribute.

7.1 Estimates of numbers of holdings and of aggregates

In the Provinces, estimates of totals or aggregates (such as total number of holdings for a district or total production of maize) will be obtained as follows: If cards are duplicated for noninterviews, the sample totals for Local Certainty holdings will be multiplied by 4 and the sample totals for small holdings will be multiplied by 16. If weights of individual holdings were adjusted for noninterviews, there would be additional weight groups. The weighted totals for the two groups of holdings (the small and the Local Certainty holdings) will be combined and added to the total for the National Certainty holdings located in the district. The resulting estimates of district totals will be added to obtain estimates for the Provinces as a whole.

Similar methods will be used to obtain estimated totals for the zones in the Northern Territory. However, the weight for small holdings will be 48. The totals for the National Certainty holdings will be added to the weighted totals for the small holdings to obtain estimated totals for each zone. (There will be no Local Certainty holdings in the Northern Territory.) The subsample of holdings for which area measurements are made will have a special weight for these measurements, which is 4 × 48 or 192.

If the tabulation is done on an electronic computer the weighting can be accomplished as part of the overall tabulation process. On conventional tabulating equipment the National Certainty holdings, the Local Certainty holdings, and the small holdings would all be tabulated and weighted separately for each cell in the tables, and the weighted totals for the different types of holdings would be added together, cell by cell.

Category	Population size group	Average population	Average number of holdings (estimated)
I	Less than 300	160	30
II	300 to 599	400	70
III	600 to 999	700	130
IV	1,000 to 3,499	1,400	250
V	3,500 and over	3,700	700

After some trial-and-error experimentation, it was found that the following rates, having convenient intervals, would give approximately the desired number of sample small holdings on the average:

Category	Sampling rate		
	For PSU's	Within-PSU	Overall
I	1 in 24	1 in 2	1 in 48
II	1 in 12	1 in 4	1 in 48
III	1 in 6	1 in 8	1 in 48
IV	1 in 3	1 in 16	1 in 48
V	1 in 1	1 in 48	1 in 48

The principle used in setting the tentative limits of the population size groups was that we wish to have a small frequency in the largest population size groups in order to reduce the task of listing these large PSU's. The other class limits and sampling rates were determined very roughly by the requirement of keeping the within-PSU sample around 15. For example, with a 1-in-2 rate, we need a PSU of average population size of 160 (or an average of 30 holdings) to get a sample of 15 holdings. The PSU's of less than 300 population have about 160 persons on the average.

Later it was necessary to modify these limits to those shown in exhibit IV-5-4. The final limits vary in the different zones; they were set where they would give frequencies in the larger population size groups, equal to or simple multiples of the interval for sampling PSU's. For example, by changing the lower limit of group IV in the Atbara River Basin from 1,000 to 1,500, we obtain a frequency of 3 PSU's in the group (1,500 to 3,499 population), which facilitates selection of 1 in 3 PSU's.

This sample plan will produce a total sample distributed as follows among the three zones (see also exhibit IV-5-4).

Zone	Sample PSU's	Small holdings in sample	National Certainty holdings
Total......	101	1,460	105
Atbara River Basin...........	44	610	60
Northwest........	33	495	30
Subic Mountains..	24	355	15

3.3 *Three-stage sample for area measurements*

Area measurements will be made in a systematically selected one-fourth of all sample small holdings in the Northern Territory. It is assumed that area data can be obtained directly from the respondent for National Certainty holdings.

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To select the sample, the enumerator will be provided with two numbers--a "start with" and a "take every" number, shown for "PSU sampling" in item (a) on the cover of the Listing Book (see exhibit IV-5-6). Both of these numbers might vary from PSU to PSU. The enumerator will count the holdings with large numbers of livestock ("X" in column 11) until he reaches his "start with" number, which will be the first sample holding. Then the sample interval, or "take every" number, is added repeatedly to identify succeeding sample holdings of this type shown in column 11. When the end of this category is reached, the sampling continues to the other category ("X" in column 12) until that category has been sampled.

4.5 *Selecting the subsample for area measurement*

After selecting the holdings, the enumerator will select the subsample of holdings for area measurement. The original sample holdings will be shown by the questionnaire numbers assigned to them in columns 14 and 15 of the Listing Book. The subsample of holdings is selected by taking one of the first four sample holdings randomly and then selecting every fourth sample holding thereafter. Instructions for making the selection will be given for "area measurement sampling" in item (a) on the cover of the Listing Book for each PSU.

5. *ENUMERATION PLAN*

As was indicated above, conditions in the Territory are such that the enumeration plan used for the Provinces requires substantial modification for use in the Northern Territory.

5.1 Interviewing and supervision

There will be 8 or 9 supervisors, each in charge of 4 or 5 enumerators. Due to the unfavorable travel conditions, the supervisor will be unable to plan the time of his visits to the enumerator so that he can select the sample as in the Provinces. There could be serious delays in completing the field work if the enumerators were required to wait until the supervisor was available to select the sample holdings. The supervisor will review the sample selection in every PSU, however, and will reselect the sample in those cases where the proper sampling procedures were not followed.

The enumerator will be assigned a single PSU (chiefdom or Special EA) at a time. He will visit his sample area, list the holdings, and select the sample holdings, using the sampling instructions for his PSU. The supervisor will visit the enumerator as often as possible but, because of travel difficulties, he may not always be able to follow a predetermined schedule. Since PSU's will not be made of equal size as in the Provinces, the time needed for listing will vary greatly for the PSU's in the Northern Territory. The sample design tends to equalize the interviewing workload but not the listing workload.

The National Certainty holdings will be interviewed generally by the enumerator closest to the holding. Because of poor communication systems, the questionnaires will not be mailed to the holders as in the Provinces. For the area of cropland, the information will be obtained by a direct question, since it is assumed that holders of large tracts of land would be able to supply such information (objective measurement will not be applied to the National Certainty holdings).

Since the enumeration plan requires the enumerator to work independently, a careful review of the enumerator's work by the supervisor is most important. If the review indicates that the enumerator is doing good work, a second PSU or several National Certainty holdings may be assigned to him.

5.2 Objective measurement of area

Objective measurement of the crop area in the holding will be carried out at a randomly selected one-fourth of the sample small holdings in the Northern Territory. In order that the measurements can be done quickly and with reasonable accuracy, a simple method of making the measurements is needed.

5.21 Making the sketch of cropland in the holding.--The greatest difficulty in measuring an area objectively is in preparing an accurate sketch of the land. After a sketch is made, the number of hectares (or other unit) can be determined in several ways.

In the Territory, the holding will often be divided into many plots of irregular shapes. Each of the plots must be sketched separately and the crop areas clearly outlined and labelled to permit identification of the five important crops separately (wheat, rice, cotton, coffee, and sisal). The sketch will be made on the graph portion of page 4 of the Agriculture Questionnaire for the Northern Territory. The graph is divided into equal-sized squares--representing 20 meters on each side; each square contains 16 dots to guide in determining fractional parts of a square. The only equipment needed will be a reasonably accurate compass, measuring chain, and a dozen or more marking poles. The poles should be red or some other highly visible color, although some of the enumerators will find it necessary to cut poles from nearby bush.

The enumerator will begin the measurement at one corner of the sample holding. Using the compass, chain, and measuring poles, he will fit a rectangle to include as much of the crop area as possible and sketch the rectangle onto the paper. With the sides of the rectangle as a base line, he will sketch the boundaries of the area by measuring the distance between the base line and the boundary at intervals of 20 meters and marking the measured points on the sketch. The points, so marked off on the sketch will be joined with straight lines which will approximate the area boundaries. The Enumerator's Reference Manual (Northern Territory), Form A-51, explains the area measurement technique in greater detail.

When the crop area consists of separate plots, the enumerator should measure and sketch each plot separately.

5.22 Determining the area.--The actual computation of the area will be done by the staff in the Central Office of the NSO. The number of complete squares within the boundaries will be counted and multiplied by the known area represented by each square. For squares which are only partially inside the boundaries, the area will be determined by estimating the proportion of dots inside the boundaries, multiplying the proportion by the known area of the square, summing over all partial squares and adding it to the area included in whole squares. The procedure will be followed for all plots in the holding. Finally, the area of the plots will be added together for the total crop area of the holding.

If the squares of the rectangle are of a suitable size, the method could be used to make estimates of yield. A sample of the squares from each crop could be selected and staked out early in the growing season for measurement at harvest time. Yield estimates could then be made for the Territory or for the zones, but not for individual holdings. Estimation of yields is not recommended as a census activity, however, due to the heavy costs of making several visits to the plot during the year. Data on yields should preferably be collected in the annual agriculture statistics program.

6. *PREPARATION OF ESTIMATES*

Estimates in the Northern Territory will be made--after adjusting for non-interviews--by weighting the sample results for the small holdings by 48 and adding the results for the National Certainty holdings. The area in cropland, which will be measured for a fourth of the small holdings, will be obtained by weighting the appropriate entries from the subsample by 192 and adding the corresponding entries for the National Certainty holdings. The estimation method is described in chapter 6 of this unit. The first-stage ratio adjustment described in that chapter may also be used in the Northern Territory.

Census objectives for characteristics involving area will be quite limited. The distribution of the holdings by size of crop area can be obtained for each of the zones. Any cross-classification of size data with tenure or other characteristics should be avoided at the zone level. However, such data should be of sufficient reliability for the Territory as a whole if the number of cross-classifications is held to a minimum.

Variance estimates can be made using the procedures described in chapter 7 of this unit.

7. *SUMMARY*

Estimates for each of the three zones in the Northern Territory are required. The sample for the Territory was designed so that most estimates could be made with no more than about a 10% coefficient of variation. The sample holdings will be selected from sample PSU's (chiefdoms and Special EA's). The PSU's will be selected with different probabilities depending on their population. Holdings will also be selected at variable rates so that the overall sampling rate is the same for every holding except the National Certainty holdings. A total of about 1,500 small holdings and about 100 National Certainty holdings will be selected in the sample. There will be no Local Certainty holdings.

Objective measurement of the area of cropland in the holding will be carried out for a subsample (one-fourth) of the small holdings. Area in cropland will be reported for all the National Certainty holdings, but will not be measured objectively.

Exhibit IV-5-4 summarizes the sample size for the Northern Territory.

Chapter IV - 6. ESTIMATES OF CHARACTERISTICS FROM THE SAMPLE

1. *INTRODUCTION*

When the enumeration and area measurements have been completed, and all the questionnaires checked in and edited, there will be some sample holdings for which no usable questionnaires were obtained. This chapter describes a method of adjusting the sample for such "noninterviews" and for questionnaires with missing area measurements. The noninterview adjustment does not apply to individual missing or inconsistent entries in the questionnaire, which in some cases are corrected by editing or imputation (supplying the data according to prescribed rules) and in other cases are allowed to appear in a "Not reported" category.

This chapter also describes a simple method of expanding the adjusted sample results to obtain estimates for the entire universe of holdings. Since three probabilities of selection were used in the Provinces, there are three expansion factors (or weights) to be used in making estimates for the districts and the Provinces. Similarly, there are three weights for the Northern Territory.

2. *NONINTERVIEW ADJUSTMENT*

In an agriculture census, it is practically impossible to obtain interviews from every holding which is specified for enumeration. Unless corrected for, the noninterviewed cases could cause a serious bias, especially in estimates of totals and aggregates. If the number of all such cases is not more than about 5% (10% at the very most), a simple noninterview adjustment may give satisfactory results.

2.1 Types of noninterviews

A holding may be a "noninterview" for a number of reasons. The noninterview adjustment is limited to those holdings for which Agriculture Questionnaires would have been filled if a completed interview had been obtained. These are cases which are reported as:

(1) No one at home at time of call

(2) Temporarily absent for a period of time

(3) Refusal

(4) No qualified respondents available.

There may also be a few cases where the questionnaire is lost, destroyed, or so poorly filled in that it is not usable. These are also treated as noninterviews if it is determined that a return visit would be impractical.

2.2 Adjustment for noninterviewed small holdings

To adjust for noninterviews of sample small holdings, data for an interviewed small holding in the same PSU and preferably in the same size-of-holding group (as shown in the Listing Book) will be substituted for the noninterviewed holding. Suppose, for example, the fourth sampled holding shown in exhibit IV-4-1 is reported as a noninterview because there was no one at home. We select the next sample holding in the same size category (the 13th sample holding in exhibit IV-4-1) and duplicate it, either by making up an identical questionnaire or by duplicating the corresponding cards for that holding. This has the effect of doubling the weight for the holding which is duplicated. If a computer is used, the duplication of questionnaires or cards is unnecessary; the procedure will be to simply double the weight of the interviewed questionnaire. If there are two noninterviews in the same PSU, a second holding (other than the one already duplicated) is selected in a similar way, and this holding is duplicated.

A slight variation in this procedure for small holdings is necessary in the Northern Territory, where every fourth sample small holding is specified for area measurements. To keep the area measurement sample self-weighted, a noninterview among the holdings specified for area measurements will require duplication of another holding having area measurements. Similarly, for holdings not requiring area measurements, interviewed holdings without area measurements should be substituted for noninterviewed cases.

2.3 *Adjustment for noninterviewed certainty holdings*

As described earlier, a greater effort will be made to obtain census data from Local Certainty holdings, and especially from National Certainty holdings. No doubt there will be some noninterviews remaining in both categories.

For Local Certainty holdings the noninterview adjustment will be made in the same way as for small holdings--by duplicating another Local Certainty holding in the same size group. Where possible the substitute holding will be in the same PSU, but it may be necessary to use an interviewed Local Certainty holding from another PSU in the same district. In either case, the selection should be made according to a predetermined procedure, such as taking the next numbered Local Certainty holding in the same PSU or, where necessary, in the next numbered PSU.

For National Certainty holdings, we can expect that there will be very few interviews available for duplication in the same PSU or even within the same district. The interviewed National Certainty holdings may also be very different from those missed. Therefore, duplication will usually not be feasible. Instead, data for the questionnaire will be imputed on the basis of the best available data.

3. *ADJUSTMENT FOR MISSING AREA MEASUREMENTS*

In some cases in the Northern Territory, the interview portion of a questionnaire will be usable but the area measurement information will be missing or not usable. These will be treated the same as other cases of individual missing or not usable entries. The area measurement data will be imputed on the basis of the best information available, and the imputed entries should be consistent with production data for the corresponding crops in Section IV of the same questionnaire.

4. *IDENTIFICATION OF DUPLICATE CARDS*

Duplicate cards will be punched, or double weights assigned, primarily for noninterviews. Another possible reason is to compensate for unusual subsampling rates used for small holdings in PSU's having a very large number of small holdings. This would require duplicating, or at most triplicating, all the small holdings in a PSU, since subsampling rates in those cases are either 1/2 or 1/3 of the usual rate. (See section 4.3 in chapter 4 of Unit IV.) Replication eliminates the need for additional weight groups in these cases.

When a card is duplicated (or a weight is doubled), a code should be punched in the duplicate card to show that it is a duplicate and to indicate the reason for the duplication. Such a code will enable the NSO staff to analyze the effect of the duplications on the census results.

Sometimes a different color is used for duplicated cards (or cards with a doubled weight) for easy visual identification in the deck. A code punched in the card is still necessary, however, in order to sort the duplicated cards from the main deck.

5. *ALTERNATIVE ADJUSTMENT PROCEDURES*

The procedure outlined for handling noninterviews was considered to be the most practical for Agrostan, and the simplest to carry out. Another method of substitution is to select the holding to be duplicated at random, from those interviewed in the same size group in the PSU. Any reasonable method of substitution may be used if it is predetermined and the number of cases is not very large. If the noninterview rate is large, no method of substitution can be very satisfactory.

A second alternative is to increase the weight of all the "interviewed" questionnaires in the PSU where the noninterview occurs; the weight would be increased to the extent needed to offset the noninterviews in the PSU. In effect, this procedure substitutes average characteristics for the missing data, which is theoretically more desirable than multiplying some cards in the PSU by 2 and not multiplying others. On the other hand, the procedure of changing the weight would result in many different numbers for the weights, and would complicate the tabulations; it is usually not feasible unless a computer is available for processing the data.

6. *POSSIBLE BIASES IN ADJUSTMENT PROCEDURES*

Duplication of questionnaires or cards to adjust for noninterviews will lead to a sample set of questionnaires or cards for the same number of holdings as if usable interviews were obtained from all sample holdings. However, some serious problems may still arise because of the noninterviews.

(1) The noninterviews may be concentrated in certain subgroups of the population, such as holdings belonging to holders who are either very young or elderly. For such a group, we may be representing these holdings by others which have rather different characteristics.

(2) If the noninterview rate (including lost questionnaires) becomes more than about 5%, efforts should be made to reduce it by retraining enumerators and requiring more call-backs.

7. *ESTIMATES FROM THE SAMPLE*

In planning for a census or survey, table formats are prepared in advance showing the kinds of estimates to be made. (Tables for most of the estimates which will be made for Agrostan have been prepared and are given in the appendix of Unit III.) After the cards have been edited, coded, and duplicated for noninterviews, they are tabulated and weighted to provide the data for the cells shown in the table formats. From the table formats for Agrostan, it can be seen that the required estimates are of the following types:

(1) Estimates of numbers of holdings and of aggregates

(2) Estimates of ratios, percentages, and averages; and estimates of proportions of holdings having an attribute.

7.1 Estimates of numbers of holdings and of aggregates

In the Provinces, estimates of totals or aggregates (such as total number of holdings for a district or total production of maize) will be obtained as follows: If cards are duplicated for noninterviews, the sample totals for Local Certainty holdings will be multiplied by 4 and the sample totals for small holdings will be multiplied by 16. If weights of individual holdings were adjusted for noninterviews, there would be additional weight groups. The weighted totals for the two groups of holdings (the small and the Local Certainty holdings) will be combined and added to the total for the National Certainty holdings located in the district. The resulting estimates of district totals will be added to obtain estimates for the Provinces as a whole.

Similar methods will be used to obtain estimated totals for the zones in the Northern Territory. However, the weight for small holdings will be 48. The totals for the National Certainty holdings will be added to the weighted totals for the small holdings to obtain estimated totals for each zone. (There will be no Local Certainty holdings in the Northern Territory.) The subsample of holdings for which area measurements are made will have a special weight for these measurements, which is 4 × 48 or 192.

If the tabulation is done on an electronic computer the weighting can be accomplished as part of the overall tabulation process. On conventional tabulating equipment the National Certainty holdings, the Local Certainty holdings, and the small holdings would all be tabulated and weighted separately for each cell in the tables, and the weighted totals for the different types of holdings would be added together, cell by cell.

The weighted sum for each cell is an estimate of the characteristic which the cell represents.

The estimate in each cell is subject to sampling error which will vary with the nature of the characteristic and the number of holdings represented by the cell. For example, a district estimate of a total or an aggregate will usually have a smaller relative error if the characteristic is associated with 5,000 holdings in the district than if it is associated with only 500 holdings. Methods of computing variances are discussed in chapter 7 of this unit.

The computation of variances will also involve a tabulation and weighting process. It is possible that the tabulation and weighting for variance computations can be done at the same time that the tabulation for making estimates is carried out. This will depend on the method used to compute variances and the type of tabulation equipment used; the sampling technician should take an active part in the planning for tabulation of the data, in order to be able to recommend a reasonable and economical method for computing variances. Tabulation processes for Agrostan are discussed in Unit VIII.

7.2 Estimates of ratios, percentages, averages and proportions

To estimate ratios, percentages, averages, and proportions, the procedure is to make estimates from the sample for the numerator and denominator and divide the estimates to obtain the required statistics. All are ratio-type estimates. For example, the percentage of tobacco holdings on which chemical fertilizer is used would be obtained as follows:

$$\frac{\text{estimated number of tobacco holdings using chemical fertilizer}}{\text{estimated total number of tobacco holdings}} \times 100,$$

where the estimated numbers in the numerator and denominator are obtained by weighting the sample results. In a few instances, the ratio of sample data may be used; for example, if the characteristic being estimated is associated only with a single class of holdings (say the small holdings in the Northern Territory where only one weight is involved), the use of unweighted sample results will provide the same estimate.

The reliability of an estimate of a ratio (percentage, average, or proportion) will depend on the correlation between the numerator and the denominator. If the two items have a high positive correlation, then the resulting ratio will usually have a much smaller relative error than either item individually.

7.3 Ratio adjustment of estimates of totals and aggregates

An estimated total or aggregate of the type described in section 7.1 is often called an "unbiased estimate" because it can be proved that its expected value is the same as the result that would have been obtained in a complete enumeration. Often, if certain data are available, it is possible to make a ratio estimate[1] which has a smaller sampling error, and which is therefore preferred even though it has a small (usually negligible) bias.

The ratio estimate can be obtained by applying an adjustment to the unbiased estimate. It requires information about both the sample and the universe in addition to that used in the unbiased estimate. Under the conditions of the Agrostan sample, it is not expected that this adjustment will have a significant effect. It might provide an important improvement in district estimates under slightly different conditions -- especially if it were not possible to nearly equalize the PSU's in terms of population or numbers of holdings. In that case, a ratio adjustment could be used to adjust for the difference between the average population of the selected PSU's in a district and the known average population of all PSU's in the district.

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[1] Note that this does not refer to an estimate of a ratio, but rather the use of a ratio to improve the estimate of another characteristic.

The adjustment assumes that if the 1-in-4 sample of PSU's has less or more than one-fourth of the true population of the district, there will be a proportionate shortage or excess in the sample numbers of holdings and in aggregates related to holdings. The principal textbooks on sampling applied to surveys contain discussions of ratio estimating methods. (See also section 4.7 of chapter 8 for more detail on method of computing ratio estimates.)

8. USE OF SAMPLING ERRORS WITH THE ESTIMATES

In addition to publishing the estimates from the survey, information should be presented along with these estimates to permit users to evaluate their accuracy. Usually it is not feasible to provide data on sampling for all items included in the survey. However, estimates of sampling errors for some typical or important items should be computed and included in the Census publications. The items selected and the method of computing sampling errors should be such as to provide as much useful information as is feasible. Several methods of computing sampling errors are presented in chapter 7.

Non-sampling errors and biases require extensive and costly research, just to obtain some very rough measures of their importance. Therefore no effort is being made to include anything about them in the basic Census publications.

Chapter IV - 7. ESTIMATES OF SAMPLING ERROR

1. *INTRODUCTION*

The tabulation program will provide thousands of estimates for holdings, crops, livestock, etc., for Agrostan. Since the Census is based on a sample there will be a sampling error associated with each item. When the size of the sample required for the census was being determined a number of speculations were made about the size of the sampling error. After the survey is completed, more precise estimates of the sampling error can be produced.

The calculation of sampling errors is costly and time-consuming; hence it will be necessary to limit the work to a small number of items. It is important that the method used, and the items for which variances are computed, be chosen so as to give results for the most important items, and at a reasonable cost. This chapter will discuss methods of computing sampling error.

2. *VARIANCE OF A SAMPLE ESTIMATOR*

The estimate from the sample for any cell of a Census table is only one of many possible results that might have been obtained. A different sample of holdings would give a different estimate with the same estimating formula, or "estimator." If estimates using a particular estimator are made from all possible samples which could be selected, one would obtain many different estimates. The distribution of these estimates would have a mean and a variance. The variance of this group of estimates is called the variance of the sample estimator (or the variance of the sample estimate). Knowing the variance, one can construct a confidence interval for the estimator (or for a particular estimate); and a statement can be made on the probability that the true value of the characteristic lies within the interval.

Obviously, one cannot select all possible samples of holdings in Agrostan. However, an estimate of the variance can be made from the observations in a single sample, if a probability sample is used. In the following discussion, the theory is developed in terms of all possible samples and known population totals. Then some methods used to estimate variances from a single sample are shown (see section 3).

2.1 *Variance of an estimate from a simple random sample*

If there are N holdings in a district of Agrostan and one of them (the i^{th}) is selected at random in the sample, an estimate (x') of the district total (X) of an item can be made by multiplying the value observed for that holding, (x_i), by N. Thus, the estimator is $x' = Nx_i$. If the sample of one holding showed 5 hectares of cultivated land and there were 6400 holdings in the district, the result of substituting these values in the estimator is to obtain an estimate of the total area of cultivated land in the district, namely 32,000 hectares. This is an unbiased estimate of the actual area of cultivated land in the district.

2.11 Definition of the population variance.--The variance of this estimate is called $\sigma^2_{x'}$, and is defined as:

$$(7.1) \quad \sigma^2_{x'} = \frac{1}{N}\sum (x'_i - X)^2 = \frac{1}{N}\sum_i^N (Nx_i - X)^2$$

$$= N^2 \frac{1}{N}\sum^N (x_i - \bar{X})^2 = N^2 \frac{1}{N}\sum^N (X_i - X)^2$$

$$= N^2 \sigma^2_X ,$$

where $X = \sum^N X_i$ is the "population total," $\bar{X} = \frac{X}{N}$ is the "population mean," and σ^2_X is the "population variance" for the item. By definition,

$$\sigma_X^2 = \frac{\sum^N (X_i-\bar{X})^2}{N},$$

which is the squared standard deviation of all units in the population, measured from the population mean.

2.12 Variance for a sample of n holdings.--With a simple random sample of n holdings the estimate of the total is

$$x' = \frac{N}{n}\sum_{i=1}^{n} x_i ,$$

and its variance is

$$(7.2) \qquad \sigma_{x'}^2 = N^2 \left(\frac{N-n}{N-1}\right)\frac{\sigma_X^2}{n} \doteq N^2 \left(\frac{N-n}{N}\right)\frac{\sigma_X^2}{n} .$$

(The symbol $\doteq$ means "is approximately equal to.") The latter form of the formula is generally used when N is greater than about 20.

When the sampling fraction $\frac{n}{N}$ is small (less than .05) the "finite correction factor" $\frac{(N-n)}{N}$ can be ignored; for example, with a sampling fraction of 1 in 100, the factor becomes $\frac{99}{100}$. Since this is nearly equal to 1, a simplified formula can be used:

$$(7.3) \qquad \sigma_{x'}^2 = N^2 \frac{\sigma_X^2}{n} .$$

2.2 *Variance for the Agrostan sample design*

The variance of an estimator from a simple random sample was discussed in paragraph 2.1, in order to give the reader an understanding of the relationship between the "population variance" and the variance of a sample estimator.

For the Agrostan Census of Agriculture much of the sample was selected in two stages; it is not a simple random sample. PSU's were selected at the first stage, and holdings were selected at the second stage. Each stage of sampling contributes to the total variance of each estimate; there is a between-PSU component of the variance, and an average within-PSU component.

The estimator of a district aggregate for a characteristic "X" for Agrostan is computed after the noninterview adjustment; it is expressed as:

x' = 16 x (sum of "X" for all sample small holdings in the district)

+ 4 x (sum of "X" for all sample Local Certainty holdings in the district)

+ 1 x (sum of "X" for all National Certainty holdings in the district).

This estimator has a within-PSU variance in the first term resulting from the selection of the small holdings within the sample PSU's; it has a between-PSU variance in each of the first two terms resulting from the selection of the sample PSU's. Local Certainty holdings contribute only to the between-PSU variance. There is no contribution to the variance from the National Certainty holdings since all of these holdings are included in the census.

2.21 Within-PSU variance.--Let us apply the discussion of section 2.1 to the within-PSU variance for the sample estimator. The formula[1] for the within-PSU variance for the i^{th} PSU in the sample is

$$(7.4) \qquad \sigma_w^2(x_i') \doteq N_i^2\left(\frac{N_i - n_i}{N_i}\right)\frac{\sigma_w^2(X_i)}{n_i} .$$

If m PSU's are selected in the sample with equal probability, the formula for the within-PSU variance becomes

$$(7.5) \qquad \sigma_w^2(x') = \frac{M}{m}\sum_i^M N_i^2\left(\frac{N_i - n_i}{N_i}\right)\frac{\sigma_w^2(X_i)}{n_i} ,$$

where $\sigma_w^2(X_i)$ is the "population variance" within the i^{th} PSU, and N_i and n_i are the number of units in the total population (sampling frame of small holdings) and in the sample, respectively. These numbers are approximately 80 and 20 in Agrostan. Since the sampling fraction $\frac{n_i}{N_i}$ is the same for each PSU, Equation (7.5) can also be written as

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[1] Note that the quantities in parentheses following are subscripts, not multipliers. They are shown in this way to facilitate printing.

$$(7.6) \qquad \sigma_w^2(x') = N^2\left(\frac{\bar{N}-\bar{n}}{\bar{N}}\right)\frac{\sigma_w^2(X)}{m\bar{n}},$$

where $N = M\bar{N}$, and the population variance $\sigma_w^2(X)$ denotes the average variance of population elements X_{ij} around their cluster means $\bar{X}_i$. Also

$$(7.7) \qquad \sigma_w^2(X) = \frac{1}{M}\sum_{i=1}^{M}\frac{N_i}{\bar{N}}\,\sigma_w^2(X_i).$$

For Agrostan the term $\frac{\bar{N}-\bar{n}}{\bar{N}}$ is approximately .75, and should not be ignored in computing the variance. Equation (7.6) shows the relation between the within-PSU variance of the estimator, $\sigma_w^2(x')$, and the population variance, $\sigma_w^2(X)$, for a sample of m PSU's of average size $\bar{n}$.

2.22 Between-PSU variance.--The between-PSU variance for a sample of m PSU's (for a district, a Province, or the whole country), $\sigma_b^2(x')$, is related to the population variance, $\sigma_b^2(X)$, by Equation (7.8).

$$(7.8) \qquad \sigma_b^2(x') = M^2\left(\frac{M-m}{M}\right)\frac{\sigma_b^2(X)}{m}.$$

Here M is the total number[2] of PSU's, m is the number of sample PSU's and $\sigma_b^2(X)$ is the "population variance" between PSU totals (for the same area) for the characteristic "X". In the sample for a district in the Provinces of Agrostan there are two sources of between-PSU variance; they are (a) the Local Certainty holdings and (b) the small holdings. The two groups of holdings would be treated as two separate strata and estimates of variance would be calculated separately using the estimated totals for each. Equation (7.8) would be applied to each group of holdings separately and the results would be added together to obtain the total between-PSU variance for the district.

2.23 Total variance.--The total variance of a sample estimator is merely the sum of the within-PSU and between-PSU variances. For an estimate of a total (x') we have

$$(7.9) \qquad \sigma_{x'}^2 = M^2\left(\frac{M-m}{M}\right)\frac{\sigma_b^2(X)}{m} + N^2\left(\frac{\bar{N}-\bar{n}}{\bar{N}}\right)\frac{\sigma_w^2(X)}{m\bar{n}}.$$

It is assumed that $\sigma_b^2(X)$ in the first term in the formula

$$M^2\left(\frac{M-m}{M}\right)\frac{\sigma_b^2(X)}{m}$$

is the sum of population variances obtained from the small holdings and from the Local Certainty holdings. The multiplier in that term is the same for both kinds of holdings, and can be simplified to the factor $M\,\frac{(M-m)}{m}$.

2.3 *Relative variance and coefficient of variation*

The relative variance of any estimate is the variance divided by the square of the estimate. For example,

$$V_{x'}^2 = \frac{\sigma_{x'}^2}{(x')^2}$$

is the relative variance of x'. The square root of the relative variance is defined as the coefficient of variation or "relative error". Thus,

$$V_{x'} = \frac{\sigma_{x'}}{x'}$$

is the coefficient of variation of the estimate x'.

3. *ESTIMATE OF TOTAL VARIANCE FROM THE SAMPLE*

Several methods, which require considerably less work than estimating components of variance, can be used to estimate the total variance of the sample estimate from the sample itself. In this section, one such method will be discussed.

3.1 *Effect of systematic selection*

The sample for Agrostan is a systematic selection of PSU's at the first stage and a systematic selection of holdings within the selected PSU's at the second stage.

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[2] In most districts the number of PSU's is greater than 20, so the factor $\frac{M-m}{M-1}$ has been replaced by $\frac{M-m}{M}$ in Equation (7.8).

The systematic selection may improve the sample, since it takes advantage of any inherent stratification which results from the order in which PSU's are listed, and of the order of the holdings within PSU's. The order may reflect geographic location, type of agricultural operations, climate, etc.

Any formula for the variance of a systematic sample usually leads to an overestimate of the variance; such an overestimate is conservative, in that the true variance may be expected to be smaller than the estimated variance. Most statisticians are satisfied with a slight overestimate of the variance, since then they may say that the estimates are probably more reliable than the computed variances would indicate.

3.2 The grouped stratum method

One of the methods for estimating variance is the grouped stratum method. If it is assumed that the m PSU's in the Agrostan sample were selected in pairs from strata (2 out of every 8 at random instead of 1 out of every 4 systematically), an estimate of the contribution to the total variance from the small holdings can be made very easily; one determines the difference between PSU sample totals for small holdings in each pair, squares the difference, weights by the square of the overall weight, and sums over all pairs of PSU's. The formula for this procedure is

$$s^2_{x'} = (16)^2 \sum_{h=1}^{H} (x'_{h_1} - x'_{h_2})^2 \cdot \tag{7.10}$$

where x'_{h_1} and x'_{h_2} are unweighted sample totals for small holdings in the PSU's in pair h, and 16 is the overall weight for the sample holdings.

To estimate the contribution to the total variance from the Local Certainty holdings (which were selected at a rate of 1 in 4) formula 7.10 would be used, with the factor $(16)^2$ replaced by $(4)^2$.

An alternative estimate of the total variance for both sampled small holdings and Local Certainty holdings can be obtained by multiplying the PSU total for each group by its proper weight, adding the two, and using the formula

$$s^2_{x'} = \sum_{h=1}^{H} (x'_{h_1} - x'_{h_2})^2 , \tag{7.11}$$

where

$x'_{h_1} = 4x_{h_1,L}$ (Local Certainty) + $16x_{h_1,S}$ (small holdings). Equation (7.11) may produce a different estimate[3] from Equation (7.10). Each equation--(7.11) alone, or (7.10) with weights 16 and 4 and the results added--will produce an unbiased estimate of the total variance; that is, the expected values of the two estimates (over all possible samples) is the same.

Calculation of variance estimates using this method is considerably simpler than most other methods since estimates of PSU totals and the squares of the sums of totals are not required. The amount of work required is minimal, making the method suitable for censuses and surveys where variance estimates are wanted for a large number of characteristics. Moreover, the method is suitable to hand computation, which may be desirable if not many variances are to be computed.

If the order in which PSU's are listed brings similar PSU's together, the assumption that the PSU's have been stratified is good. The method described above will give a closer estimate of the true variance than the assumption (for example) that the PSU's were selected by simple random sampling from the whole list of PSU's.

If the sample units are selected with unequal probabilities, PSU sample totals would have to be weighted before the differences are taken and then Equation (7.11) would be used. With a self-weighting sample (which may be the case for some items, such as the number of small holdings) the weighting can be done in a single operation using Equation (7.10). For an estimate of the number of Local Certainty holdings, Equation (7.10) would be used with a factor of $(4)^2$, rather than $(16)^2$.

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[3] Equation (7.11) introduces a cross product term between $4x_{h_1,L}$ and $16x_{h_1,S}$ in each stratum; its expected value over all strata (over all samples) is zero.

3.3 Estimates of variance for districts

For most districts the number of PSU's in the sample is small (less than 20), and the pairing of PSU's (as if selected from strata) will have very few degrees of freedom, so that the estimate of variance will not be very reliable. A better estimate of the variance of a total will be obtained by grouping several districts together, computing the estimate for the group of districts, and adjusting the estimate to take into account the number of PSU's in each individual district.

Example 1: Bolivar Province, which had 221 rural EA's and 42 urban EA's in 1970, will have 62 PSU's in the sample. Variances can be computed using 31 "strata", each represented by 2 PSU's which are paired in the order of selection.

Estimate for a single district: Consider the single district Monaco, which had 47 EA's in 1970. Suppose 12 of these have been selected as PSU's for the sample. A variance for this district is estimated by multiplying the estimated variance for 62 PSU's in Bolivar Province by $\frac{62}{12}$.

Example 2: Rajpur Province had 1057 rural EA's and 175 urban EA's in 1970 in 13 districts (or combinations of districts). The EA's were grouped into 1048 PSU's, and 264 were selected for the sample.

It is not necessary to use all 264 PSU's in the variance computation. A sample of 30 to 50 can be selected systematically; each of these is then paired with the next PSU selected in the Province, and the 60 to 100 PSU's can be used to compute the variance.

Estimate for whole Province: If 50 pairs of PSU's were used in the variance computation, an estimate of the variance for the whole of Rajpur Province can be made by multiplying the estimate just found by $\frac{264}{100}$ to take account of the fact that there were actually 264 PSU's in the sample in the Province (not 100).

However, since Rajpur is a large Province, with much variability in climate and type of agricultural operations, it would be better to group the 13 districts into 2 or 3 sub-areas, which are relatively similar, and to compute an estimate of the variance for each sub-area, using about 40 pairs of sample PSU's in each sub area.

3.4 Estimates of variances for large Provinces

The variance for a large Province is the sum of the variance for the sub-areas within it. The variance for a single district is obtained in the same way as in Example 1, using the variance for the sub-area in which the district lies as the basis for the computation.

For example, if Ranchi district (which has 21 PSU's in the sample) is in a sub-area having 85 sample PSU's, the variance for the sub-area could be computed using 80 PSU's and then multiplying by $\frac{85}{80}$. For Ranchi district, itself, the estimate of the variance would be $\frac{80}{21}$ times the variance, computed from the 80 PSU's.

3.5 Estimates of variances for the nation

The sample for the whole country of Agrostan contains about 3,000 PSU's. A quick estimate of the variance of a total, which may be sufficiently reliable for crops which are grown in all areas of the country (such as maize or beans), can be made by selecting a systematic sample of 100 pairs of PSU's and computing a variance by the paired-PSU procedure. Of course the estimate obtained must be multiplied by a factor (in this case $\frac{3,000}{200} = 15$) to get an estimate of the variance for the whole country.

The reason that such short cut methods can be used is that the variance of a major crop is a fairly stable characteristic. An estimate of the variance using 200 PSU's will be quite reliable, and not differ too much from the estimate obtained using all 3,000 PSU's. Moreover, sampling errors are usually stated in percentages, with about 2 significant figures; an error of 10% in the estimate of the sampling error is not usually considered serious.

A better method of obtaining national variance estimates is to add the corresponding variances for all the Provinces. Since variances are required for each Province, this is a simple way to obtain the variance for the whole country. It has the added advantage of giving more reliable estimates for crops (such as cotton) which are grown only in a few Provinces.

4. ESTIMATE OF COMPONENTS OF VARIANCE FROM SAMPLE

After the survey estimates have been obtained, the sampling procedures should be examined with a view to designing more efficient samples for current agricultural surveys and for the next agriculture census. This usually requires an examination of the components of the variance for a few of the most important characteristics needed for planning surveys; this task can be carried out after the census operation is completed. Even though these computations can be delayed, it is important that they be carried out.

4.1 *Between-PSU variance*

The total variance is the sum of the within-PSU and the between-PSU variances; therefore an estimate of one of the components can be obtained by computing the other and subtracting from the estimate of total. Mathematically, this can be expressed in terms of the population variances as:

$$\sigma_b^2(X) = \sigma^2(X) - \sigma_w^2(X)\ . \tag{7.12}$$

The total variance can be estimated directly from the sample, by the method described above. Methods of estimating the within-PSU population variance are given in the next section.

4.2 *Within-PSU variance*

The formula for estimating the within-PSU variance is

$$s_w^2(x') = \frac{M^2}{m^2}\sum_{i=1}^{m} N_i^2\,\frac{N_i - n_i}{N_i n_i}\,s_w^2(X_i) \tag{7.13}$$

$$= \frac{M^2\bar{N}^2}{m^2}\,\frac{\bar{N}-\bar{n}}{\bar{N}\bar{n}}\sum_{i=1}^{m}\frac{N_i}{\bar{N}}\,s_w^2(X_i)$$

where

$$s_w^2(X_i) = \frac{1}{n_i - 1}\sum_{j=1}^{n_i}\left(x_{ij} - \bar{x}_i\right)^2 \tag{7.14}$$

is an estimate of the population variance $\sigma_w^2(X_j)$ based on the sample holdings within the PSU. A simplified formula for computation is

$$s_w^2(X_i) = \frac{1}{(n_i - 1)}\left[\sum_{j=1}^{n_i}(x_{ij})^2 - \frac{\left(\sum^{n_i} x_{ij}\right)^2}{n_i^2}\right].$$

4.3 *Remarks*

The components of variances can be calculated for the nation as a whole, for Provinces, or for individual districts, depending on the level at which estimates will be made for the survey or census that is being planned. For a national census where estimates will be made at all levels, the components of variances for a few districts will be needed to guide the statistician in designing the sample for future surveys. For current surveys designed to produce national estimates only, the components of variance for a national sample will be needed. Often the statistician can use estimates of components for a few districts or Provinces as being indicative of the components for the whole nation. In any event, the PSU's can be sub-sampled when making estimates of variance for the whole country, in order to reduce the amount of work to a manageable level. Highly reliable estimates of components of variances are usually not required, since components of variance will be used primarily in trying to optimize future sample designs and since several different designs may be close to the optimum.

4.4 *Using components of variance*

Components of variance may be used in several ways in optimizing a sample design, depending on the general form of the sample design. For a simple design such as the one for the Agrostan Census of Agriculture the components can be used together with cost data (or assumptions of relative costs) to find approximately the optimum number of clusters (m) and holdings within the clusters ($\bar{n}$) for a given precision. Usually the optimum is quite broad, so that fairly large changes in the number of PSU's selected, and in the number of holdings in the sample PSU's, may not greatly affect the reliability of the estimates. One of the responsibilities of the sampling statistician is to know when the range around the optimum is rather broad.

5. *VARIANCE OF THE ESTIMATE OF A RATIO AND OF A RATIO ESTIMATOR*

In an earlier section it was mentioned that variances for estimates of ratios such as percentages, averages, and proportions, and ratio estimates of totals or aggregates require a separate discussion. The estimator $r = \frac{x'}{y'}$ (of the ratio $R = \frac{X}{Y}$) and the estimator $X'' = rY$ (of the level of the characteristic X) are related, since x'' is Y times r. In the estimator of aggregates, Y is a known total from an independent source (for example, the 1970 Census population) and does not depend on the sample; hence it makes no contribution to the sampling error. In fact, the relative errors of r and x'' are identical.

5.1 *Population variance of a ratio estimator*

The relative variance of the ratio (r) of two random variables can be approximated very closely, if the sample is moderately large. The formula is as follows:

$$(7.15) \qquad V_r^2 \doteq V_{x'}^2 + V_{y'}^2 - 2V_{x',y'}$$

where

$$V_{x'}^2 = \frac{\sigma_{x'}^2}{X^2}, \qquad V_{y'}^2 = \frac{\sigma_{y'}^2}{Y^2}$$

and

$$V_{x',y'} = \rho_{X,Y} \frac{\sigma_{x'y'}}{XY} .$$

Here $\rho_{X,Y}$ is the correlation coefficient between X and Y for the sample design being used.

It can be shown easily that

$$(7.16) \qquad V_{x''}^2 = V_r^2 .$$

The corresponding population variances are:

$$(7.17) \quad \sigma_r^2 = R^2 V_r^2 \doteq R^2 \left(V_{x'}^2 + V_{y'}^2 - 2V_{x',y'}\right)$$
$$\doteq \frac{1}{Y^2} \left(\sigma_{x'}^2 + R^2\sigma_{y'}^2 - 2R\sigma_{x',y'}\right)$$

and

$$(7.18) \quad \sigma_{x''}^2 = X^2 V_r^2 \doteq Y^2 \sigma_r^2$$
$$\doteq \sigma_{x'}^2 + R^2 \sigma_{y'}^2 - 2R\sigma_{x',y'}^2 .$$

5.2 *Sample estimate of the variance of a ratio estimator*

Sample numbers may be used to make estimates of the variances in Equations (7.15) to (7.18). The estimates are respectively:

$$(7.19) \quad v_r^2 = \frac{s_{x'}^2}{(x')^2} + \frac{s_{y'}^2}{(y')^2} - \frac{2(s_{x',y'})}{x'y'}$$

$$s_r^2 = \frac{1}{(y')^2} \left(s_{x'}^2 + r^2 s_{y'}^2 - 2rs_{x',y'}\right)$$

$$s_{x''}^2 = s_{x'}^2 + r^2 s_{y'}^2 - 2rs_{x',y'} .$$

These estimates all involve ratios of random variables, and consequently are subject to the biases inherent in ratio estimates.[4] If the sample sizes are relatively large, the biases will be small, and can be ignored. In practice, the estimates of variances using Equation (7.19) may be considered to be approximately unbiased, if the sample is fairly large, and the population is not highly skewed. For Agrostan, we have removed most of the skewness of the population by the use of the National and Local Certainty lists.

5.3 *Estimate of a ratio or proportion*

The most important ratio estimates in the Agrostan Census will be proportions obtained by taking the ratio of two characteristics; for example, holdings on which cropland is irrigated as a proportion of holdings with land in crops. The estimate of such a ratio is obtained by dividing the estimated totals for the two characteristics. Suppose the ratio of these two characteristics in a certain district is $r = \frac{1,618}{2,682} = 60.3\%$.

An approximate estimate of the rel-variance of the ratio may be obtained by applying the formula

$$(7.20) \qquad V_r^2 \doteq V_{x'}^2 - V_{y'}^2 .$$

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[4] The estimates in Equation (7.19) are "consistent" estimates; that is, the bias decreases and approaches zero as the size of the sample becomes very large.

To derive Equation (7.20), note the relationship

$$V_{uw}^2 = V_u^2 + V_w^2 + 2V_{uw} \qquad (7.21)$$

for the product uw, and consider the identity

$$x' = y' \frac{x'}{y'} = y'r.$$

Using (7.21), the variance of x' becomes

$$V_{x'}^2 = V_{y'}^2 + V_r^2 + 2V_{y',r} \qquad (7.22)$$

In many situations, the correlation between y' and r is very small so that $V_{y',r} \doteq 0$ and $V_{x'}^2$ is approximately $V_{y'}^2 + V_r^2$. Transposing terms gives Equation (7.20).

6. ILLUSTRATION OF VARIANCE COMPUTATION

It will be assumed that the variance program in Agrostan will be limited to about 20 items consisting of (a) obviously important items (b) items for which variance computations have been requested, and (c) a selection of items with high, low, and medium variances. The items might include:

(1) Total number of holdings by tenure classes
(2) Land in holdings
(3) Arable cropland
(4) Average size of holding
(5) Number of cattle on hand
(6) Fertilizer used - amount
    - proportion of holdings using fertilizer
(7) Maize harvested - area
    - yield
(8) Groundnuts harvested - area
    - yield
(9) Coffee harvested - area
    - yield
(10) Cash from sale of agricultural products
(11) Number of wheel tractors used on holding
(12) Irrigated land - number of holdings
    - area
(13) Hired workers for pay in cash
(14) Cash wages paid to hired workers
(15) Number of family workers

Exhibit IV-7-1 illustrates a worksheet which can be used in the grouped stratum method of calculating variances. For Bolivar Province, the 62 PSU's are used to calculate variances. The two characteristics under consideration are (a) total number of holdings and (b) number of holdings using chemical or other commercial fertilizer.

Column 8 of Form A-281 gives the covariance which is needed to calculate variances for the ratio of the number of holdings using chemical fertilizer to the total number of holdings. The totals on the bottom line of columns 2 and 5 give the total number of holdings and the total using fertilizer; the totals for columns 4 and 7 give the variance estimates for these items.

Chapter IV-8. ALTERNATIVE SAMPLE DESIGNS

1. *INTRODUCTION*

By "sample design" we refer to the total plan for collecting information and drawing inferences about a population. The sample design thus includes sample plan, enumeration plan, and estimating methods. These three aspects of the sample are so closely related that a change in any one usually requires changes in the others, and decisions about all three must be made jointly, especially the first and third aspects.

In the previous chapters, two sample designs were described. The design for the Provinces satisfies the following conditions. It is basically a two-stage sample of holdings, with modified enumeration areas (EA's) of nearly equal population size as first-stage units. Equal probability sampling is used at both stages. Very large holdings (National Certainty holdings) are included with certainty and medium size holdings (Local Certainty holdings) are sampled at an intermediate rate. It is assumed that holders can give usable information on all items in an interview. The principal method recommended for estimating population totals is a simple expansion by the reciprocal of the sampling rate for each of the three categories of holdings.

The design for the Northern Territory satisfies the same conditions with several exceptions. The first-stage units are not equal in size and they are selected with unequal probabilities; there are no Local Certainty holdings. Also, since it is assumed that holders generally cannot give usable information on land area, a subsample of holdings is measured objectively. Estimates are made by simple expansion as in the Provinces, since the overall probability of selection is constant.

The possible choices among alternative sample designs in a country depends greatly on the types of administrative divisions, the number of units of each type, their relation to the publication level required, and the personnel available to take the Census.

The following tabulation shows the types and numbers of administrative divisions in Agrostan. The last column shows the relation of each type to the sample design by identifying those which are primary sampling units (PSU's) and those for which estimates are required in Agrostan.

Administrative division	Number	Relation to sample design
Provinces, total....	1	Publication level
Province................	13	Publication level
District (modified).....	150	Publication level
Subdistrict............	1,093	--
EA (modified)..........	14,936	PSU's
Northern Territory..	1	Publication level
Zone....................	3	Publication level
Territorial district....	18	--
Chiefdoms and EA's......	1,986	PSU's

The smallest administrative division, the chiefdom or EA, was chosen as the PSU in both parts of the country (modified EA's in the Provinces). Estimates of specified accuracy are required for the Provinces as a whole, and for each Province and each district making up the Provinces, but only the total and each of the three zones making up the Northern Territory require publication.

Other countries may have different census objectives, different size (area, population, and amount of agriculture), different types of administrative divisions, different resources, and other variations from the conditions assumed for Agrostan. Possible ways of changing the Agrostan design to fit various conditions are discussed in this chapter.

2. *MODIFICATIONS RELATED TO CENSUS OBJECTIVES*

Most countries will want to publish census results for the smallest administrative division feasible. What is feasible will depend on the intended uses of the data and the resources available. Furthermore, the objectives may vary for different items of information.

2.1 Smaller publication areas or greater accuracy

In Agrostan, the smallest area requiring estimates is the district, having a minimum of about 2,500 holdings. There are still two smaller areas--the subdistrict and the EA. The EA was chosen as the PSU. If estimates were required for areas smaller than districts, such as subdistricts (or if estimates for districts were required to have greater accuracy), it would be necessary to increase the sample size or to change the distribution of the sample. We could take one of the following steps, which are listed in order from the simplest and least expensive (and also least effective) to the most drastic and expensive (but most effective). We could--

(1) Increase the number of sample holdings per PSU.

(2) Increase the number of sample PSU's.

(3) Increase both the number of holdings and the number of PSU's in the sample.

(4) Use different sampling fractions in districts (or subdistricts) of different sizes.

(5) Omit the PSU stage and select as many holdings as required throughout the district, either singly or in clusters of neighboring holdings from the list of all holdings.

We would then choose the least costly step that would be expected to produce the desired results. Step 1 alone would probably not be sufficient; there would be too few PSU's per subdistrict (since these are smaller than districts) either to provide good subdistrict estimates or to substantially improve the district estimates. The district sample in Agrostan includes one-fourth of the PSU's. Even if we increased this number by taking one-half of the PSU's (step 2), there would still be too few sample PSU's in most subdistricts for acceptable subdistrict estimates; and only a slight improvement in the accuracy of district estimates would result. Step 3, combining steps 1 and 2, would have a greater effect but probably not enough to produce subdistrict estimates of the standard of accuracy set for districts in Agrostan. (Step 4 is a variation of step 3.) It would probably be necessary to take step 5, and select a single-stage sample of holdings.

In another country, where the frame contains a much larger number of PSU's and the sample is selected at a lower rate than one-fourth, it would be possible to obtain more improvement within the two-stage plan. In considering other countries, it is important to note that the sampling rates at each stage, as well as the overall rate ($\frac{1}{4} \times \frac{1}{4} = \frac{1}{16}$), depend upon the number of administrative divisions at different levels. The fact that first- and second-stage rates are equal for Agrostan is accidental. The resulting number of sample holdings, which is 20 x 20 = 400 (plus certainty holdings), may be a suitable number for other countries and other levels of publication. One can expect to obtain estimates of about the same accuracy as Agrostan district estimates for a publication area with a sample of 400 holdings located at 20 spots (PSU's) throughout the area, and supplemented by 50 to 100 more heavily sampled large holdings in the area. In a country larger than Agrostan, the result 20 x 20 = 400 might be obtained by first- and second-stage rates of 1 in 10 and 1 in 4, with an overall rate of 1 in 40, or by another combination leading to an overall rate less than that used in Agrostan.

2.2 Larger publication areas or less accuracy

If results are needed only for larger areas, one would still need about 400 holdings in a minimum of 20 PSU's (supplemented by large holdings) in each such area. One would probably still use a two-stage sample and would choose as PSU's (or as the basis for forming PSU's) a unit which is sufficiently numerous and sufficiently large for the purpose. There should be at least 60 of these units in the universe and the units should contain, on the average, 60 or more holdings. Then it would be feasible to select a sample of about 20 PSU's and 20 holdings per PSU to represent the area. The sample would still be a two-stage sample, but the PSU might be a somewhat larger unit than the EA's in Agrostan. If there are several types of administrative divisions in the country satisfying these conditions, one should select as the PSU the smallest unit that is administratively feasible, which might still be the Population Census EA. The 400 holdings needed for the larger area would be obtained from a lower overall sampling rate, which might result from lower rates at either or both stages compared with Agrostan. However, the number of first-stage units should be at least 20, if possible.

If, on the other hand, we could accept district estimates of lower accuracy than for Agrostan, the sampling rates would be reduced by the converse of the first three steps described above--that is, by selecting fewer holdings per PSU, fewer PSU's per district, or both. The converse of step 5 would be to increase the number of stages of sampling, but this might not be feasible. In general, with a given sample plan, changes in the required accuracy level result in changes in the required size of sample; a smaller sample is sufficient for less accurate estimates, and conversely. This results from the fact that sampling error is related inversely to $\sqrt{n}$, and this relation is roughly true even for complex designs.

2.3 *Different requirements for different items*

There may be many items in the questionnaire which can be estimated from a smaller sample than the general level required for other items, for one of the following reasons:

(1) They are less variable than the basic items for which the sample was designed.

(2) They are to be estimated only for larger areas than the basic items.

(3) The level of accuracy required is lower than for the basic items.

(4) They are attributes (for example, questions answered by "yes" or "no").

It may be sufficient to obtain these items from a subsample of the original sample. The subsample is usually selected by a simple procedure, such as systematic sampling. Information is obtained at the same time as for the original sample of holdings. The questions may be part of a longer version of the regular questionnaire or they may appear on a separate questionnaire, which is filled in addition to the regular questionnaire for the subsample of holdings. Since there would be no saving in travel costs from further clustering, the sample should be selected in all original sample PSU's. The subsample may be selected by a method similar to that used to select the subsample for area measurements in the Northern Territory. Where it is feasible to divide the items into two categories requiring significantly different sample sizes, this procedure will result in a substantial saving in interviewing and processing time and costs.

3. *MODIFICATIONS RELATED TO SIZE OF COUNTRY*

For many types of surveys, the complexity of the sample design will increase with the size of the country. This is especially true when only national or large-region estimates are required. However, it is usually the objective of a census (whether sample or complete) to produce results for rather small areas, and the sample must be designed to provide estimates for these small areas. The size of these areas is frequently about the same from country to country. The sample design for these small areas will therefore be similar, whatever the size of the country. The enumeration plan may be affected, however. If the number of small areas to be published is much larger than the number for Agrostan, significant changes would be required in the number of enumerators, the training program, the field organization, and other aspects of the census.

4. *MODIFICATIONS RELATED TO AVAILABILITY OF RESOURCES*

Many assumptions were made about the availability of previous census data, maps, money, personnel, and transportation facilities in the Agrostan design. The design in the Northern Territory provides an example of some variations in these assumptions. It includes the case where there was no previous agriculture census, and maps from the population census were not very complete or accurate. Many of the assumptions about resources are reflected in the census objectives, such as the accuracy required, and the level of publication. Their effect on sample design has already been discussed in section 3. Some possible assumptions about resources may have other effects, which are not entirely reflected in changed objectives; they will not necessarily lead to the design for the Northern Territory. This section contains general comments on some of the situations already included as examples in the Agrostan design, and on other possibilities not yet discussed.

4.1 No previous agriculture census

In a country which, like the Northern Territory of Agrostan, had no previous census of agriculture, the sample will probably be less efficient and a larger sample will be needed for given levels of accuracy. Stratification may be less effective, and cutoffs for defining the larger holdings (which are to be selected with certainty) may be more difficult to choose. The minimum criteria for defining a holding may have to be set lower in order to be certain not to exclude too much of the production. Much more pretesting of questionnaires and procedures will be required. If there has been a previous population census with well identified EA's, the sample design may be similar to that used in the Provinces of Agrostan. However, the samples should be slightly larger in each area requiring estimates, in order to offset the reduced efficiency of basing the sample on population counts which may not be closely related to holdings.

4.2 No previous complete population census

For Agrostan, it was assumed that a complete population census would be taken shortly before the Agriculture Census. This Census would provide a frame for selecting the agriculture sample. However, in some countries the population census might be taken on a sample basis. In that case, the frame used to select PSU's for the population sample may be usable to select PSU's for the agriculture sample census. If those units were too large or too variable in terms of numbers of holdings for an efficient agriculture sample, map work and field work may be required to modify them. The field work can be reduced by the procedure applied in the Provinces of Agrostan, using rough measures of size, based on the best available information, and selecting the sample before subdividing units which have measures greater than one; this procedure limits the work of subdividing to only the selected units (see chapter 3).

For a given level of publication and degree of accuracy a larger sampling fraction will usually be needed for a sample agriculture census than for the sample population census, since not all households are associated with holdings, and agricultural data are often more variable than population data. Hence it would usually not be feasible to select the sample for the agriculture census by including only a subsample, or even all, of the population sample households associated with agricultural holdings.

4.3 Simultaneous sample censuses of population and agriculture

In some cases, it may be advisable to take a sample population census and a sample agriculture census simultaneously or nearly so. A list of all households in the country or a complete list of households within selected PSU's, together with identification of households having agricultural holders, can provide the frames for both samples. With a Listing Book such as that used in the Provinces of Agrostan, for example, column 3 entries identify households, and column

7 entries identify holdings. The population sample might include 1 in 10 of the households in column 3, and the agriculture sample might include 1 in 4 of the entries in column 7. Then the probability that any household would be in both samples would be only about 1 in 40. The person making the list might also fill the population census questionnaire. Another enumerator could conduct the interview for the agriculture questionnaire on a separate visit. This will reduce the training burden on the interviewers resulting from the variety of concepts involved, and it will reduce the burden placed on respondents at any one time; it would also assure that very few respondents would be in both samples. If it is feared that duplication of the same households in both samples will reduce cooperation, unbiased procedures can be used to eliminate the duplicates. The sampling rate would be increased to offset rejected duplicates.

Units to be included with certainty would generally not be the same for the population and agriculture samples. Institutional units would not necessarily be associated with large holdings and large holdings would usually not have large populations. National and Local Certainty holdings would be identified as in Agrostan, and lists of the former would be compiled in advance. These would be checked and the Local Certainties would be identified from information obtained during the listing operation. This operation would be performed by the population sample enumerator if the division of labor suggested above is followed. The data collection form for the listing operation would be somewhat longer, in order to obtain the information needed for differential sampling of larger units for both samples.

4.4 More detailed maps available

If maps are available showing an indicated number of holdings related to identifiable areas smaller than Agrostan's EA's, they may be used to improve the efficiency of the sample, even though the indicated numbers are inaccurate and out-of-date. These numbers should, however, be fairly well correlated with actual numbers of holdings. Small, compact areas with identifiable boundaries (hereafter called "segments") can be formed on maps and used as single-stage or second-stage sampling units. Several variations are possible, as discussed below. All these methods reduce the amount of listing required, while increasing the amount of map work.

4.41 Single-stage segments with single measures of size.--In the simple case of a single stage sample, there is a large amount of map work. The map of each EA (or other small administrative unit) is divided into segments containing approximately equal numbers of holdings.[1] Definite limits would be set on the expected number of holdings per segment--for example, 3 to 9 (average 6) or 5 to 15 (average 10), depending on the amount of detail usable for segment boundaries on the maps. A segment averaging more than 8 or 10 holdings would probably not be efficient, since holdings which are located near each other are likely to be similar. A geographically ordered sample, probably stratified by urban-rural residence, is selected systematically.

4.42 Single-stage segments with varying measures of size.--If map detail is not sufficient to make identifiable segments, all of which are close to the desired size, the segments are allowed to vary in size and additional measures of size are assigned to those above the desired range. For example, suppose it is desired to have segments of about 6 holdings (the number 6 might be chosen because it is the number of holdings an enumerator can be expected to interview in one day, including time for travel to the segment and possibly for contacting an official). Segments could be formed containing an estimated 6 holdings, and all segments in the range of 4 to 8 holdings would have single measures of size. A segment in the range of 9 to 15 holdings would have a double measure of size. Segments with more than 15 expected holdings could be subdivided before the sample selection is made, or assigned larger measures of size.

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[1] In practice, segments might be set up according to numbers of housing units (HU's); assumptions can be made as to the relationship of HU's and holdings.

Segments are then selected systematically from the cumulated measures of size, following the procedure used for EA's in chapter 3. If, for example, a segment with a double measure is selected, there is a choice of two procedures, each resulting in a self-weighted sample:

(1) The enumerator or supervisor divides the double segment into two parts in the field, using visible boundaries. One part is selected at random for the sample.

(2) The entire segment is listed, and a sample of 1 in 2 holdings is selected from the list.

4.43 Segments as second-stage units.--When the number of segments that would be required for specified accuracy of a publication area is large, it may be feasible to select segments in two stages. With two-stage sampling, a somewhat larger number of holdings and segments would be required; two-stage sampling would be used only if there would be a net saving resulting from the lower travel costs for a given accuracy level. The number of sample PSU's in a district should not be smaller than about 20.

When segments are used as second-stage units in this way, it is often convenient to select first-stage units with probability proportional to size (based on the expected number of holdings) and to select segments with probability inversely proportional to size. This eliminates the need for equalizing the size of PSU's, and gives a self-weighted sample, with approximately equal workload (number of segments and number of holdings) in each selected PSU. It also reduces the error due to variability in PSU size, resulting from the fact that it is often not possible to make the PSU's nearly equal in size (see section 5.5 below). It also eliminates the need for segmenting (dividing into segments) the entire area for which estimates are required. Segmenting will be done only in the selected PSU's.

In the example above, the segments may vary in size fully as much (relatively) as the PSU's in Agrostan. The variability in segment size does not have as serious an effect on accuracy of estimates, however, because the number of sample segments in an area requiring estimates is many times as large as the sample number of PSU's.

4.44 Use of cadastral survey maps.--In some countries, detailed maps showing land utilization by small plots and by ownership are available for revenue purposes. They may have serious errors or biases in areas reported, but still may provide supplemental information which can be used to improve sampling or estimating methods. Because they are on an ownership rather than an operator (holding) basis, and because of their identification with the revenue system, it may not be feasible to use them as a source of individual holding information for sample selection.

The cadastral registers or area data which are usually associated with such maps may be available to provide information needed to assign measures of size to PSU's, or as supplemental information in ratio estimates (on the latter use, see section 4.8 below).

4.5 Less detailed maps available

The Northern Territory of Agrostan provides an example of the situation in which available maps show too little detail to be useful in forming PSU's, or even in assigning census enumeration work. Instead, a list of administrative areas, with their preliminary 1960 population counts, was used as a starting point for preparing a frame of PSU's.

The procedure is to obtain as complete a list of areas as possible, with the help of field work if necessary, and to obtain whatever information is available on their size (number of holdings or some quantity correlated with the number of holdings). PSU's can then be selected with unequal probabilities, following the method of the Northern Territory or with probability proportional to the measure of size. By keeping the overall probability equal for the selection of holdings, the sample can be made self-weighting.

4.6 *More money and staff available*

The census objectives of accuracy and type of detail to be published require a certain amount of personnel and budgetary resources. Increased availability of these resources would permit carrying out some experiments in sample design as part of the Census; the purpose would be to obtain information which will permit the design of more efficient future samples for intercensal surveys or later censuses, and to study nonsampling errors. Some such research features are described in the next section.

4.7 *Use of interpenetrating subsamples*

Sometimes it is useful to design the sample so that it can be divided into a number of independent subsamples of the same design--called "interpenetrating" samples, which can serve several possible purposes. Some of these purposes and the applicable methods are discussed below. The first two methods are applicable to the Agrostan sample as originally designed.

4.71 Successive estimates.--Preliminary district estimates can be made from a systematic subsample of the entire district sample. Because of the importance of "certainty" holdings, the interpenetrating subsamples would be identified only among the small holdings, and all certainty holdings would be included in each successive estimate. Thus, for example, each small holding in the sample might be identified as belonging to one of four subsamples, each obtained by starting with a different random number from 1 to 4. This would be done in every sample PSU after making duplicates for noninterviews. If we call the four subsamples of small holdings A, B, C, and D, successive estimates would be based on subsamples A; A and B; A, B, and C; and A, B, C, and D; plus (in every case) the certainty holdings. For the first such district estimate, sample totals would be combined as follows to obtain estimates of aggregates.

1st estimate:

Enumerated total for National Certainty holdings

+ 4 × (enumerated total for Local Certainty holdings)

+ 64 × (enumerated total for sample small holdings in A group) = $64 \Sigma A = A'$

where the multiplying factors are reciprocals of the probabilities of selection.

For the second and successive estimates, the estimate for certainty holdings would remain unchanged, but the estimate for small holdings would be an average of independent estimates from the subsamples.

2nd estimate of small holdings:

$(A' + B') \div 2$ where B' (which is obtained by the same estimating formula as A') = $64\ \Sigma B$.

3rd estimate of small holdings:

$(A' + B' + C') \div 3$ where $C' = 64\ \Sigma C$.

4th estimate of small holdings:

$(A' + B' + C' + D') \div 4$ where $D' = 64\ \Sigma D$.

Since the number of sample small holdings in a district often would not be exactly divisible by 4, more exact expansion factors should be based on the exact number of small holdings in the groups. For example, if there were 387 sample small holdings in a district, the A, B, C, and D groups would vary by one unit and would consist of 96, 97, 97, and 97 instead of identical numbers. Then the formulas for estimating the aggregates A', B', etc., for small holdings would be:

$$A' = \left(\frac{387}{96} \times 16\right) \sum A;$$

$$B' = \left(\frac{387}{97} \times 16\right) \sum B;$$

etc.

The difference between A' and B' can provide the basis for a very rough estimate (one degree of freedom) of the sampling error in the second estimate for small holdings:

$$s(\text{of second estimate of small holdings}) = s_2 \div \sqrt{n}\ ,$$

where s_2^2 is the estimated population variance of the expanded estimates, A' and B'; and n is the number of such expanded estimates which are combined (namely, 2). Since the second estimate of small holdings is $(A' + B') \div 2$,

$$s_2^2 = \frac{\left[A' - \frac{(A' + B')}{2}\right]^2 + \left[B' - \frac{(A' + B')}{2}\right]^2}{n - 1}$$

$$= \frac{(A' - B')^2}{2} \quad \text{and}$$

$$s_2 = \frac{|A' - B'|}{\sqrt{2}} = \text{estimated standard deviation of } A' \text{ and } B'.$$

Thus s (of second estimate of small holdings) =

$$\frac{s_2}{\sqrt{n}} = \frac{|A' - B'|}{2}$$

The term $|A' - B'|$ refers to the absolute value of the difference $(A' - B')$.

Similarly, the three estimates of A', B', C' lead to an estimate of the population variance

$$s_3^2 = \frac{1}{2}\left[\left(A' - \frac{A' + B' + C'}{3}\right)^2 + \left(B' - \frac{A' + B' + C'}{3}\right)^2 + \left(C' - \frac{A' + B' + C'}{3}\right)^2\right]$$

based on two degrees of freedom.

s (of third estimate for small holdings) =

$$\frac{s_3}{\sqrt{n}} = \frac{\left(\text{estimated standard deviation of } A',\ B',\ \text{and } C'\right)}{\sqrt{3}} .$$

s (of fourth estimate for small holdings) =

$$\frac{s_4}{\sqrt{n}} = \frac{\left(\text{estimated standard deviation of } A',\ B',\ C',\ \text{and } D'\right)}{\sqrt{4} = 2} .$$

This procedure does not provide an estimate of the component of sampling error contributed by the Local Certainty holdings.

4.72 Evaluation of sampling error.--As described in section 3 of chapter 7, the Agrostan sample will be divided into independent subsamples for the purpose of estimating sampling error, even when no successive estimates are made. That division provides error estimates for the total estimate (not for small holdings only), and it is based on more degrees of freedom than are available by the procedure described above.

4.73 Evaluation of "enumerator effect".--The usual and least expensive way to distribute the interviewing work among the enumerators is to assign each enumerator a separate area such as a primary sampling unit, or a group of primary sampling units, as in Agrostan. However, it is also possible to assign the sample holdings within one or more PSU's to two enumerators. If the two groups of holdings are selected so that each is an independent subsample, and these samples are large enough, an analysis of the results obtained by the two enumerators can provide a means of evaluating the "enumerator effect". This term (also called "interviewer effect") refers to the differences which cannot be explained as sampling error, but must be attributed to consistent tendencies of individual enumerators to obtain different results from the same population. If the entire sample is thus divided among pairs of enumerators, it is possible to separate an enumerator variance as a component of the total variance. Travel costs are, of course, greater than for the usual sample design.

In a number of experiments, this method has revealed surprisingly large variability related to enumerators, presumably due to their attitudes, preconceptions, or to different ways of asking questions or recording answers. These studies have led to the conclusion that, in addition to having at least a moderately large number of sample PSU's in a publication area, there should be a moderately large number of enumerators, so that enumerator differences can balance out. From this viewpoint, a large number of part-time enumerators would be better than a smaller number of full-time enumerators. Where it is feasible, self-enumeration (having the respondent fill the questionnaire himself) with follow-up of nonrespondents may give better results than interviews.

It is theoretically possible to adapt a sample design such as the Agrostan design for the purpose of studying the enumerator effect merely by assigning enumerators so that two or more have independent subsamples within the same territory. Usually it is more efficient, however, to design the sample somewhat differently, because of the increased costs from having two enumerators working in the same area. Larger units might be needed for PSU's or PSU's might be chosen in contiguous pairs to minimize the additional travel inherent in this type of interpenetrating sample.

4.8 *Use of first-stage ratio estimates*

Reference was made in section 7.3 of chapter 6 to the possibility of using a ratio estimating method to improve estimates. The method is equivalent to multiplying the original estimate (x'), obtained from a simple expansion of the sample data, by a factor which will adjust for the fact that a particular sample which was selected will be "higher" (or "lower") than the whole population. The factor is a known total for the whole population (Y) divided by the estimate (y') of the same known total, which is made by using this particular sample. Both Y and y' are based on data obtained from a source which is independent of the current survey (for example, from a previous census or cadastral records). In the method suggested in chapter 6, the known information (not used in the simple estimating method) was the 1970 population for the sample PSU's and for all PSU's. This procedure is called a "first-stage ratio adjustment," since it is based on data for PSU's only (not individual holdings). The resulting estimate is

$$x'' = x'\left(\frac{Y}{y'}\right)$$

Where there are different weight groups and National Certainty (NC) holdings are selected from all PSU's, care must be taken in applying the ratio adjustment. National Certainty holdings must be treated as a separate universe not requiring adjustment. If they comprise a substantial part of the total to be estimated, it may be necessary to subtract the value of the supplementary variable for NC holdings from the numerator and denominator of the adjustment factor. This may not be necessary if the supplementary variable is population or number of holdings, but would be desirable if it is an aggregate such as land in holdings. For example, in making a district estimate of an aggregate for a variable X in one of the Provinces of Agrostan by this method, using land in holdings as the supplementary variable, the following steps would be involved:

(1) Adjust each weight group for noninterviews (small holdings, Local Certainty holdings, and National Certainty holdings).

(2) Obtain corresponding sample totals of X adjusted for noninterviews.

(3) Multiply each sample total by its appropriate weight (16; 4; 1) to obtain estimated aggregates (x').

(4) Add the estimates (x') for the small holdings and Local Certainty holdings to obtain the universe estimate excluding National Certainty holdings.

(5) Compute the first-stage ratio factor based on land in holdings:

$$\frac{\text{Total land in holdings in the district excluding land in NC holdings}}{(\text{Land in holdings in sample PSU's excluding land in NC holdings}^{2}) \times 4.} = \frac{Y}{y'}$$

(6) Multiply the sample estimated total excluding National Certainty holdings obtained in step (4) by the factor obtained in step (5).

(7) Add the total[3] for X for National Certainty holdings in step (2) to the adjusted total obtained in step (6).

An example of another supplementary variable which might be used for the first-stage ratio estimate is the number of holdings at a previous census date.

Before deciding whether to use a ratio estimating method, some rough analysis should be made by the sampling statistician, considering the expected correlation between important items being estimated and the supplementary variable, as well as expected variances of each. The correlation must be reasonably large (for example, +.7 or more), and the relative variance of the supplementary variable must not be much larger than that of the items estimated in order to obtain enough improvement to justify the additional work.

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[2] That is, land in National Certainty holdings associated with the sample PSU's only.

[3] This is a total rather than a sample estimate, since all National Certainty holdings are in the sample. The adjustment for (possible) non-responses should be so small that this can still be considered a "total", rather than an estimate.

5. OTHER CONSIDERATIONS AFFECTING SAMPLE DESIGN

In addition to census objectives and available resources, a country may differ in many ways from Agrostan. The sample design should reflect the differences.

5.1 Number and definition of weight groups

In any sample design, the number of different weight groups should be kept as small as possible; they should be defined in a manner that makes it easy to classify the holdings. For example, it would be desirable to use a single definition of Local Certainty holdings, if the proportion of holdings in the various size groups does not differ greatly from area to area within the country.

Even if the number of large and medium-size holdings differs widely throughout the country, a cutoff point could be used which is lower than necessary for some areas. This would give a uniform field procedure and simplify tabulation and control, but would require a somewhat larger sample.

5.2 Holdings operated by city residents

It has been assumed throughout the Agrostan case study that an agriculture census will obtain data relating to holdings--that is, on an operator basis. The further assumption made in Agrostan--that it is feasible to sample holdings by way of operators' households--may not always be appropriate. In the definition of the universe for Agrostan, it was assumed that holdings of operators living in the built-up parts of the cities (plus those of less than $\frac{1}{10}$ hectare) could be excluded with only a slight loss of coverage of the total agricultural production.

In a country or part of a country where a substantial number of holders live in the city and operate holdings outside the city, some other method must be used to provide a satisfactory frame of holders (or holdings). It is usually not feasible to canvass all housing units in the cities, in order to find those having a household member who operates a holding. It may be feasible to ask a question in a population census taken shortly before (or concurrent with) the agriculture census, which will identify the households of such absentee agricultural operators, and thus provide a frame for sampling them.

If this procedure cannot be applied, it may be very difficult to obtain complete coverage of these holdings, and to assure that they have a chance of being selected in the sample. A possible procedure is to list not only the heads of households living in the sample enumeration areas, but also every person not living there who has agricultural operations in the enumeration area.[4] By checking "yes" or "no" answers to various questions, the enumerator can identify persons with holdings in the enumeration area but living outside the enumeration area, into one of the following classes:

(1) Those who have agricultural operations where they live.

(2) Those who do not have agricultural operations where they live.

For the latter, the enumerator obtains the address, and a follow-up is made to obtain a questionnaire. For the former, no follow-up is needed, since it is assumed that these holders will be included in the census where they live.

Similar methods have been used in connection with segment samples, where it may be somewhat easier to account for all agricultural land, and thus get full coverage of the absentee operators.

5.3 Communal forms of tenure

As described in Unit III, there are various forms of tribal, collective, and cooperative tenure under which agricultural land is held. These variations affect questionnaire design and methods of data collection more than they affect sample design. It is assumed that the larger communal holdings would be comparable to National or Local Certainty holdings in Agrostan, and that there is a "person-in-charge" who can be treated as the operator. Where separate pieces of land are individually owned by or assigned to members of a cooperative, these individuals will be treated as the operators. If individual holdings consist only of "kitchen gardens" for family use, while the major production is from communally operated land, treatment would depend on whether Census objectives include information about such gardens. If so, the questionnaire for the communal operation should be supplemented by a form for getting information from all or part of the households in the cooperative.

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[4] Some absentee holders may have agricultural operations in several EA's; to avoid duplication, some rule should be established, such as recording the holding only in the EA where the largest portion is located.

5.4 *Use of "villages" or "barrios" as a frame of PSU's*

In many countries the smallest administrative unit for which there is a complete list (and for which there is likely to be data available which can be used in designing the sample) is a group of inhabitants with some tribal or ethnic ties (known as a "village" in some Asian and African countries) or as a minor civil division (such as a "barrio") in some Latin American countries. The unit may contain a concentration of households surrounded by more scattered homes. Such administrative units are similar to the "chiefdoms" of Agrostan's Northern Territory. Since they are likely to be quite variable in population size, the sampling method used in the Northern Territory or the method of sampling with probability more exactly proportional to size, as described below, may be used.

If these units do not comprise a frame covering all possible holdings in the population, procedures must be devised to select a sample of those which are not included.

5.5 *Sampling with probability proportional to size*

In Agrostan it was assumed that information was available on the size of PSU's, which to some extent reflected the numbers of holdings. Since actual information on numbers of holdings was not available, population was used. It was assumed that, within the agricultural universe (which excluded densely populated city areas) population would be correlated with number of holdings. In selecting PSU's from cumulated measures of size assigned to EA's in the Provinces, we used a selection probability roughly proportional to the size of EA's as a device to reduce map work. In the Northern Territory, where PSU's were more variable in size, they were classified in several size groups, and the probabilities of selection were more closely related to size. Still another procedure is to use probability proportional to a measure of size (PPS). The difference between these methods is shown in the following hypothetical example.

PSU (or EA)	Population	Provinces		Northern Territory sampling rate for PSU's of this size	PPS probability*
		Measure of size	Probability of selection		
1	350	1	$\frac{1}{4}$	1 in 12	$\frac{20 \times 350}{50,000}$
2	640	1	$\frac{1}{4}$	1 in 6	$\frac{20 \times 640}{50,000}$
3	400	1	$\frac{1}{4}$	1 in 12	$\frac{20 \times 400}{50,000}$
4	1,200	2	$\frac{1}{2}$	1 in 3	$\frac{20 \times 1,200}{50,000}$
(etc.)	(etc.)	(etc.)	(etc.)	(etc.)	(etc.)
80	50,000	90			

*Probabilities giving 20 sample PSU's from the total of 80.

A self-weighting sample is obtained in all three cases, by using at the second-stage a probability (sampling rate) which is the inverse of that used at the first-stage, thus giving a constant overall probability. The advantage of using PPS is that (if the population count is highly correlated with the number of agricultural operations) it results in a more nearly equal workload of interviews (number of sample holdings) for each sample PSU, and usually leads to a smaller variance in the estimates.

If more than one unit is selected from an entire stratum with PPS and without replacement the second and succeeding units are biased toward smaller units (since larger units are likely to be selected first and do not have their proper probability in later selections). There are several methods of avoiding this bias. A simple one consists in selecting systematically with PPS. In the hypothetical example above, the interval for systematic selection would be $\frac{50,000}{20} = 2,500$. A random number from 0001 to 2500 is the starting number and it selects the first PSU for which the cumulated population total equals or exceeds the random starting number. Successive sample PSU's are identified by repeatedly adding the interval 2500 to the random starting number and finding the selected PSU from the cumulated population number.[5]

5.6 Complete agriculture census to be taken

Even when a complete (or nearly complete) agriculture census is to be taken, some of the principles of sample design discussed above can be used for one or more of the following purposes:

(1) To extend the scope of the census (see section 2.3 above)

(2) To specify a sample for early tabulation (see section 4.71 above)

(3) To study the "enumerator effect" (see section 4.73 above)

(4) To specify a sample for a post-enumerative survey to check on the quality of census data.

(5) To specify a sample of small holdings, to be taken with a complete census of all larger holdings. This would be similar to the Agrostan design in form, but the definition of certainty holdings would have a much lower cut-off, for example 10 hectares. Holdings between $\frac{1}{10}$ hectare and 10 hectares would be sampled, and those of over 10 hectares included with certainty.

(6) To specify a sample for an intercensal survey to follow the census, for obtaining current agricultural estimates.

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[5] The procedure is discussed and illustrated in Lecture 10 of the following publication of the U.S. Bureau of the Census. Supplemental Courses for Case Studies in Surveys and Censuses, Sampling Lectures, ISP Supplemental Course Series, No. 1, Washington, D.C., 1968.

Chapter IV-9. OTHER USES OF SAMPLING

1. INTRODUCTION

The use of sampling in the field enumeration activities of a census is one of the major uses of sampling. However, there are a number of other areas in which sampling can be used in the census program. These other uses include: (a) pretesting, (b) quality control of pre-enumeration activities. field enumeration, and processing, and (c) the evaluation program.

2. SAMPLING IN PRETESTING

For a large operation such as a census, plans and procedures must be carefully developed. Wording of the questions and the design of the questionnaire, as well as the check-in procedures and data-processing operations, should be pretested before they are used in the census. Time and cost to carry out a function also must be analyzed in the pretests.

Not all aspects of pretesting are suited to probability sampling. Pretesting of the questions to be asked may require a different selection of respondents than that needed for obtaining data on the time and cost of performing the enumeration. Likewise, an entirely different sample may be appropriate for pretesting an office operation. Properly designed samples in the pretest may assist in making the most suitable decisions.

2.1 *Pretesting questionnaires and other forms*

After a decision has been made as to the information wanted from the census, it is necessary to determine the order of asking the questions, and the wording which will obtain the answer most easily and most correctly. Normally a proposal is made after consultation between the data users and the subject matter specialists in the NSO. The proposal may involve several alternative versions of the questionnaire with different question wording. Several pretests may be made to test different groups of questions and to make successive changes in questions. Some of this pretesting may be done first in the NSO office.

It is then necessary to test the questionnaire (or the several versions of it) in an actual interview situation. One relatively inexpensive method is to test one or two topics at a time as a supplement to the current household sample survey, which is being conducted in Agrostan. If the topic requires several questions or is dependent on another topic, the related questions should be pretested as a group.

Eventually it is necessary to test the questionnaire as a whole. The respondents may be designated in one of several ways:

(1) Scientific selection of a sample from the general population; for example, a sample of EA's throughout a Province, or a sample of holdings in a district.

(2) Arbitrary selection, based on convenience; for example, persons living near the NSO office.

(3) Purposive selection. Respondents may be operators of holdings that are identified as having a particular characteristic; for example, to test the questions on production of cotton, the holdings might be those which sent cotton to the various processing plants. Or to test responses on tenure, the selected holdings might be owners listed on tax rolls.

The method of scientific selection is usually preferred if sufficient time and resources are available to carry out the pretest successfully. If the sample is large enough to yield reasonably reliable estimates, data can be tabulated from the pretest questionnaires and analyzed statistically. This can be a particularly useful method for testing alternative wordings for certain questions or alternative layouts of the questionnaire. The sample is divided randomly into several subsamples, and the various alternatives are assigned at random to the subsamples. If the results among the groups differ, this will indicate that some of the alternatives are more effective than others. One may not know, however, which alternative is best to use unless some independent data are available with which the sample results can be compared. Of course, one must not attempt to test too many alternatives at a time.

Purposive selection may be desirable in order to reflect important small subgroups of the population, such as persons living in sparsely settled areas, persons speaking different languages, or persons with widely differing cultural backgrounds.

Arbitrary selection has obvious disadvantages in that the results may be biased; however, considerations of money, time, and personnel may lead to this choice. It will usually be better than making decisions in the NSO with no field pretesting at all.

The testing area may also be chosen to provide some information on costs of travel in rural areas, time required to enumerate a holding, etc.

At the time of the pretest of the questionnaire, a decision should have already been made as to the size and type of enumeration areas to be used, functions of the field supervisor, the amount of training and supervision he receives, and the amount of time and the methods he, in turn, uses in training and supervising the enumerators. Pretesting can serve to point up major problems which may require changing some decisions which have already been made for field operations.

2.2 *Pretesting time and cost*

From the pretests some information will be obtained on the time it takes to enumerate the questionnaire, the time to travel from one housing unit to the next, and how these times vary from one part of the country to another. This type of information is useful in deciding the basis for paying enumerators, and for determining whether they are receiving a reasonable payment for the work done. It also assists the budget office in determining how much the field work for the census will cost. If the cost is too high relative to the total budget, alternative procedures will have to be set up for some parts of the program--field work, office work, tabulation, or publication--or more money may have to be obtained.

2.3 *Pretesting office procedures*

The questionnaires which are collected during pretesting can be used to decide on the office procedures to be followed in processing the census. This applies to all phases of the office operations.

2.31 Check-in procedure.--The forms and operations required for receipt and control of the census enumeration (and particularly the control of the census sample) should also be tested. Several forms and procedures may seem equally usable. An office test, with randomization among clerks, can assist in deciding which process is most likely to be successful.

2.32 Office processing.--Later units in this case study describe the processing operations and quality control procedures to be used. The decision as to which quality control procedure to use, and how to apply it, can be made after running some tests on the results collected in the pretest enumeration. For this purpose, the testing should be done on a random basis--that is, a probability sample should be used, with work assigned to clerks in such a way that valid distinctions can be drawn from the results of the tests.

2.4 *Experimental census*

Before taking the census throughout the whole country, it should be conducted in an area (one or more districts) of moderate size and with varied characteristics, so that all aspects of the census operation can be tested. Preferably, this is done about a year in advance of the census date. After that date, little change can be expected to be made in the form of the questionnaire, in the field procedures, or in the office processing. Nevertheless, it is desirable to carry out such an exercise to discover if there are any major problems which will arise in the conduct of the census. If a serious problem is encountered at any stage, steps can still be taken to correct it, or to reduce its effect.

For this purpose, the area in which the experimental census will be conducted is usually not selected on a probability basis. The training of supervisors and enumerators is conducted, questionnaires are developed, the census is enumerated, the results are processed (edited, coded, and tabulated), and a final publication is produced. Every part of the census operation is followed through, including computation of variances for items which are enumerated on a sample basis.

3. *SAMPLING IN QUALITY CONTROL OPERATIONS*

The conduct of a census, from the planning and the first office operations through the publication of the results, requires many operations. Most of these are on a large scale. Some are so important that they must be verified completely; others can sometimes be verified on a sample basis. This section mentions the operations in which sampling can be used and those operations which directly affect the sampling.

3.1 Quality control in pre-enumeration activities

The decisions as to the kind of census to be taken, the time at which it will be taken, the questions to be asked, and the types of data to be tabulated are usually either required by law or determined by a group of high-level personnel in the government of the country, sometimes by the chief executive himself. After the general form of the census has been decided, there is much preparatory work to be done. A few of the major preparatory operations are mentioned below.

3.11 Mapping.--If possible, a map of each PSU is provided for the enumerator. The usual procedure is to delineate the PSU's on maps for the subdistricts in each Province, using definable boundaries such as roads, rivers, well-traveled paths, railroads, tops of mountain ridges, etc. Hence, the identification of PSU's, and the mapping work which goes with the PSU's should be checked 100%; there should be as little likelihood of error in the maps and descriptions of the PSU's as is humanly possible.

3.12 Format of questionnaires and listing books.--The census uses a number of questionnaires, listing books, and other forms, both in the field and in the office. The questionnaires particularly should be checked thoroughly by several persons before printing, to be sure that there are no errors either in the wording of questions, the location of questions on the form, numbering of columns, etc.

The persons who design the questionnaires should try to make them as easy to use as possible, both in the field enumeration and in office processing. Hence, the format of all field-use questionnaires should be checked 100%, preferably by several persons.

3.13 Printing.--After the forms have been received from the printer, a check is required to see that--

(1) The printing has followed the format specified.

(2) The printing is reasonably uniform.

(3) The pages have been assembled properly in the Listing Book.

These and similar checks can be made on a spot-check basis; no scientific sampling is usually involved. The verifier should assure himself that the printing job is well done, but a very detailed check should not be necessary.

3.14 Review of training materials and manuals.--The materials used for training district supervisors and enumerators, particularly in the sampling aspects of the census program, are very important and should receive as much care in preparation as the questionnaires themselves. In the same way, the Enumerator's Reference Manual should be as complete and free from errors as it is possible to make it. It is recommended that all the materials be reviewed.

3.15 Distribution of materials.--The Listing Books, Agriculture Questionnaires, maps, training materials, reference manuals, and forms for control of the field operation will be distributed in stages--first to the PCO, and then to the district supervisors, who will give the materials for individual PSU's to his enumerators. Spot-checks may be adequate at the Province level. However, the district supervisor must check all the materials very carefully to be sure he has received all the materials that he should receive and that they are identified properly.

3.2 *Quality control in field enumeration*

The responsibilities of the district supervisor during the enumeration include controlling the quality of work of the enumerator, insofar as possible. Some of these tasks must be performed on a 100-percent basis and some can be reviewed on a sample basis. In the case of the latter, the sample may be a scientifically selected one for some purposes and a spot-check for others.

3.21 Checking PSU boundaries.--As part of his training, or immediately thereafter, the district supervisor should check the boundaries of the PSU's which are to be assigned to his enumerators. He should do this for every sample PSU so as to avoid having any enumerator waste time locating the boundaries or having him enumerate the wrong areas.

3.22 Observation of enumeration.--As early as possible after the start of enumeration, the district supervisor should visit each enumerator and observe him while he is listing or enumerating. The district supervisor is asked to check some portions of the enumerator's work entirely; for other portions, he is asked to check a sample of pages, lines or items. He should be given specific instructions on how to select the sample, how to record his findings, and when to take remedial action.

3.3 *Quality control of office processing*

As with the field enumeration, quality control should be an integral part of the office operations. The amount of checking which is required will depend upon the operation.

Some of the checking of office operations will involve 100% verification and others will require sample verification. In still other cases, an examination of summary records may be adequate; for example, a comparison of the number of NC holdings that are tabulated for a district with the number on the NC list for that district; if the numbers are inconsistent, further checking is obviously required.

3.31 Editing, coding, key punching, tabulating.--Sampling is used extensively in the quality control of data-processing operations to assure high quality work at substantially lower cost than if all the work is verified. In some cases, the work of a clerk is verified 100%, then reduced to sample verification as long as his work is of acceptable quality.

3.32 Control of materials.--One operation which is often given too little importance in the census program is the control of census documents and records. The task of distributing and receiving materials involving large numbers of individuals through several levels of field supervision, the control of these materials to and from various processing operations and the final storing and cataloguing of the records are most important to the success of the census.

3.33 Review of data.--Unit IX of this case study discusses the review and evaluation of data collected in the census. The chief procedure used is a check for consistency of results. However, not every figure which is published can be examined; hence, a large part of the checking (particularly for small-area data) will be done on a reduced basis. Either a scientific sample of areas can be checked, or the checking may be done on a more informal basis. Larger and more important areas will obviously be checked more thoroughly.

4. *SAMPLING IN TABULATIONS*

Frequently one finds that the census is costing more money than was budgeted for it; or some national emergency arises which gives the census low priority. In such a case, the census staff, including the sampling technician, should be prepared to do some (if not all) of the census tabulations on a sample basis.

As a part of planning for the census, it would be desirable to have a set of priorities established, so that if it is necessary to cut back, it can be done in an intelligent and scientific way. This requires a knowledge of the real requirements for the census data. Which are absolutely essential? Which can be cut back to the Province level? Which need be produced only at the national level?

An analysis of the real uses of census data is a very difficult undertaking, and one can never be sure he is setting the priorities correctly. But some attention to this problem should be part of the early planning for the census, so that if a cutback is necessary, it can at least be an orderly one.

For broad policy-making purposes and in order to have an overall view of the progress of a country, there are some tabulations which need to be made only at the national level, with perhaps a few regional breakdowns. For tabulations such as these, it is not necessary to process all of the estimated 75,000 holdings in the sample in Agrostan.

There are also tabulations of a very specialized type for which local data would be so detailed as to make the tabulations impractical to use. Here again tabulation of the entire file is not necessary for large-area tabulations.

When small-area detail is not required, a sample of questionnaires may be tabulated to provide data which would be too expensive if the whole file were processed. It is obvious that such a sample, with a much smaller set of questionnaires to be tabulated, will cost less and save time. Another possibility would be to tabulate a subsample of the punched cards.

5. *SAMPLING FOR AN EVALUATION SURVEY*

No matter how carefully a survey is planned, or how careful and dedicated the persons who carry it out are, errors are always made. For example, in an agricultural census, it is extremely difficult to identify each holding that is associated with each household in a sample PSU. Generally some are missed.

The usual practice is to conduct a small-scale sample survey as soon as possible after the census to determine how well the census enumerated the holdings. A post-enumeration survey (evaluation survey) is intended to do this.

6. *SAMPLING FOR INTERCENSAL SURVEYS*

Sampling is used extensively for intercensal surveys primarily because of the time and cost to carry out a census. Since intercensal surveys are concerned with current information on a country-wide basis (with possibly some regional or urban-rural breakdown), a well-designed sample should be quite adequate. The particular sample design would depend very much on the type of information that is being collected and the source materials that are available. Listings of holdings from the previous census can be used as a frame, or the sample can be based on information known about the entire census PSU. In the case of the latter, the measure of size can be used for stratification or a sample of the census PSU's can be selected with probability proportional to size.

As years pass, and one gets further away in time from the date of the census, it becomes less useful as a frame for sample surveys. After a few years, the size of a PSU may be quite different from its size on the census date. Also, small agricultural holdings may become large in size, and vice versa. However, there may be no other source which is as good as the census and it may be necessary to use it as a basis for the sample in spite of its limitations. In any case, when census data are used as a frame, provisions must be made to update the frame.

Chapter IV -10. SUMMARY OF ACTIVITIES

1. *INTRODUCTION*

The sampling technician plays a central role in the preparation and the carrying out of a sample census of agriculture. However, his activities must be closely coordinated with those of other specialists who work on the plans and in the operation of the Agriculture Census. It is important, therefore, that the sampling technician know what activities he will be involved in, and that he completes his work on these activities according to schedule so that the work of other specialists will not be delayed.

From past experience on sample censuses and surveys, the sampling technician will be aware of the general categories of activities in which he should participate. As he develops his role under each of the general categories, he will arrive at specific procedures which must be carried out by himself, by someone under his supervision, or by some cooperating office. In this chapter we will first list the general duties of the sampling technician and then summarize the specific duties, particularly activities relating to the enumeration phase of the Agrostan Sample Census of Agriculture.

To some extent, the list of activities is given in approximate chronological order. The sequence of events will not always be clear, however, since many of the procedures are carried out at the same time.

1.1 General responsibilities of the sampling technician

The various specialists involved in the census such as the subject-matter specialists, the geographer, the data processing specialist, etc., may ask the opinion of the sampling technician on any aspect of the census plans. In fact, the sampling technician should make an attempt at gaining a general understanding of census operations carried out by other specialists. The main responsibilities of the sampling technician can, however, be grouped into a few broad categories. These categories are given below.

(1) In cooperation with other members of the Agriculture Census Working Group, decide on the administrative areas for which estimates will be made and the level of reliability required by the data users; also, decide on the types of items or characteristics which will be included in the publication program.

(2) Determine what materials and data are available from past censuses and surveys for designing and selecting the sample; review the sampling methods and data from the 1961 Census of Agriculture and from Current Agriculture Surveys; check the availability of suitable EA maps and preliminary data from the 1970 Population Census. Review the table outlines for the 1971 Census of Agriculture; advise on the amount of detail in the table outlines in terms of reliability of the estimates.

(3) Prepare the sample design for enumeration. Decide on the frame for each stage of sampling, enumeration plan, method of estimation, and method for computing variances.

(4) Set up a time schedule for the various operations of sample selection so that coordination of sampling and nonsampling activities can be carried out (see exhibit IV-10-1).

(5) Prepare detailed instructions for each operation in the sample selection; design the worksheets and office forms required to prepare the sampling frames and select the sample units.

(6) Participate in the design of the Listing Books, Agriculture Questionnaires, and other forms.

(7) Determine sampling procedures for (a) pretesting, (b) quality control of pre-enumeration work, field enumeration, and data processing, and (c) the evaluation program. Participate in these activities and recommend changes.

(8) Review tabulated results for statistical significance, inconsistencies, or processing errors. Assist in the preparation of the final report.

1.2 *Summary of specific sampling procedures in Agrostan*

Once the sample design is decided upon, the specific procedures required to select the sample, collect the data, and make the estimates can be developed. The list given below contains the specific activities related to sampling which were developed for the Agrostan Sample Census of Agriculture. All of the activities are not entirely sampling activities and, in fact, some may involve other specialists. However, most of the activities that involve the sampling technician in either a major or minor role are included on the list.

1.21 Provinces.--The following activities apply to the operations directly or indirectly related to sampling operations in the 13 Provinces:

(1) Combine small districts (those with fewer than approximately 2,500 holdings) either with other small districts or with contiguous large districts. Prepare a list of districts or combinations of districts for which estimates will be made.

(2) Assist in preparing instructions for compiling the list of National Certainty holdings for each district.

(3) Form PSU's from the 1970 Population Census EA's (combining small EA's and subdividing very large ones) and assign measures of size.

(4) As required, prepare PSU cards to facilitate stratification. List the PSU's on the PSU Sample Selection Sheet, Form A-261 (exhibit IV-3-8) in the order they appear after stratification. If no stratification is needed, list the PSU's in numerical order.

(5) Select a systematic sample of PSU's using the same sampling rate throughout the Provinces.

(6) Cooperate with the Geography Division to prepare maps for the sample PSU's. Designate for subdividing those EA's which have more than one measure of size (one of which is a sample PSU). Assist in the development of a numbering system for the sample PSU's.

(7) In cooperation with the Agriculture Division, design the Listing Book that will be used in preparing the second-stage sampling frame. Set the size limits for the Local Certainty holdings in the Provinces.

(8) Assist in preparing instructions for listing holdings in the Listing Books. Prepare instructions for the subsampling of the holdings.

(9) In cooperation with the Field Operations Division, develop the enumeration plan, paying particular attention to the prevention of bias in the listing and subsampling operations.

(10) Assist in preparing procedures for (a) pretesting, (b) quality control of pre-enumeration activities, observation and review of the field enumeration, post-enumeration office operations such as editing, coding, card punching, and tabulation, and (c) the evaluation program.

(11) Develop the method of weighting the sample results to make estimates and prepare the necessary instructions. Review the noninterviews and recommend action to keep the noninterview rate to less than 5%. Prepare instructions for the noninterview adjustment.

(12) Review the procedure used to check in the completed Agriculture Questionnaires and Listing Books.

(13) Specify the tabulation needs for the computation of estimates of variances.

(14) Compute variances (using the form exhibited in chapter 7).

(15) Review the preliminary tabulated estimates for reasonableness. Consider the size of the estimates obtained and their variances. Look for errors which may have resulted from improper application of the sampling instructions. Make sure the amount of detail required by the tables can be obtained from the sample with sufficient accuracy.

(16) Review the analytic and descriptive statements for the published reports; prepare the section on the description of the sample and sampling error.

1.22 Northern Territory.--The following activities include the sampling operations applicable to the Northern Territory:

(1) Assist in preparing instructions for compiling the list of National Certainty holdings for each zone.

(2) Make a list of chiefdoms and Special EA's.

(3) Form five population size strata by zones; stratify within each of the five groups.

(4) Prepare PSU cards, as needed for stratification.

(5) Select a sample of PSU's using a different sampling rate in each size group.

(6) Cooperate with the Geography Division to prepare maps for the sample PSU's. Assist in

the development of a numbering system for the sample PSU's.

(7) In cooperation with the Agriculture Division, design the Listing Book that will be used in preparing the second-stage and third-stage sampling frames.

(8) Assist in preparing instructions for listing holdings in the Listing Book. Prepare instructions for the subsampling of the holdings for the Agriculture Questionnaire and for area measurement.

(9) Same as (9) to (16) for the Provinces.

1.3 *Flow chart of sampling activities*

The sampling technician may wish to construct a flow chart of the major sampling activities. Such a chart will help him to schedule his work in the sequence in which it should be carried out to avoid unnecessary delays in any particular sampling operation. Exhibit IV-10-2 is a flow chart for Agrostan.

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APPENDIX

(Exhibits are arranged in numerical sequence; titles of the exhibits are listed in the table of contents)

Exhibit IV-2-1. WORKSHEET, FORM P-270: PRELIMINARY COUNT FROM THE 1970 CENSUS OF POPULATION FOR RANCHI DISTRICT IN RAJPUR PROVINCE

Form P-270
AGROSTAN
(April 1970)

WORKSHEET

PRELIMINARY COUNT

1970 CENSUS OF POPULATION

A Sheet 1 of 1
B Province Rajpur (code) 10
C District Ranchi (code) 12
D Posted by Amos Kuntz Date 5 October 1970
E Verified by Bonnie Maines Date 16 October 1970

Sub-district No. (1)	EA No. (2)	Urban-rural* (3)	Population (4)	Sub-district No. (1)	EA No. (2)	Urban-rural* (3)	Population (4)	Sub-district No. (1)	EA No. (2)	Urban-rural* (3)	Population (4)
01			4,671		010	2	687		010	2	536
	001	1	1,342		0[illegible]	2	441		011	2	349
	002	1	60[illegible]		012	2	559		012	2	357
	003	[illegible]	702		013	2	591		013	2	414
	004	1	698		014	2	725		014	2	307
	005	1	[illegible]268		015	2	384		015	2	673
					016	2	292				
02			8,492		017	2	384	06			9,067
	001	2	448		018	2	616		001	2	364
	002	2	211						002	2	807
	003	2	716	04			6,189		003	2	493
	004	2	199		001	2	585		004	2	566
	005	2	449		002	2	581		005	2	386
	006	2	586		003	2	417		006	2	457
	007	2	783		004	2	483		007	2	503
	008	2	447		005	2	311		008	2	216
	009	2	553		006	2	555		009	2	60[illegible]
	010	2	416		007	2	234		010	2	471
	011	2	684		008	2	416		011	2	497
	012	2	467		009	2	470		012	2	489
	013	2	538		010	2	513		013	2	638
	014	2	905		011	2	625		014	2	877
	015	2	622		012	2	406		015	2	574
	016	2	468		013	2	593		016	2	540
									017	2	585
03			9,706	05			7,433				
	001	2	189		001	2	460				
	002	2	469		002	2	603				
	003	2	948		003	2	635				
	004	2	671		004	2	428				
	005	2	629		005	2	587				
	006	2	588		006	2	463				
	007	2	512		007	2	622				
	008	2	708		008	2	495				
	009	2	313		009	2	507				

*Code 1 - Urban; Code 2 - Rural

Exhibit IV-2-2. PRELIMINARY POPULATION COUNT: RURAL ENUMERATION AREAS BY SIZE GROUPS, FOR DISTRICTS IN RAJPUR PROVINCE: 1970

District	Number of sub-districts	Rural population	Number of rural EA's 1970									Average number of persons per rural EA
			Total	With population--								
				Under 200	200 to 299	300 to 399	400 to 499	500 to 599	600 to 699	700 to 799	800 or more	
Total............	90	520,087	1,057	32	64	175	372	224	97	55	38	492
Adoni..................	5	21,739	42	-	1	4	21	9	4	2	1	518
Adjmer..................	9	47,445	99	4	7	12	43	17	8	5	3	479
Baroda..................	6	41,476	85	2	6	9	41	15	6	4	2	488
Bellary.................	4	24,418	48	1	4	5	19	12	3	3	1	509
Bhopal..................	6	30,123	61	1	3	11	20	14	6	3	3	494
Chanda..................	7	44,935	92	2	4	13	44	16	5	3	5	488
Chirmuri................	10	49,689	107	6	5	22	39	17	9	7	2	464
Dabhor..................	3	11,685	22	-	2	3	4	6	3	2	2	531
Jaipur..................	2	10,052	20	1	1	3	6	7	1	1	-	503
Kanpur..................	6	31,221	65	-	6	15	18	13	6	3	4	480
Karur...................	6	33,948	74	4	9	17	23	13	3	2	3	459
Kistna..................	2	15,578	32	-	2	9	9	6	3	2	1	487
Kolar...................	7	39,181	81	3	4	24	19	16	8	4	3	484
Poona...................	3	26,754	53	2	3	11	16	7	9	3	2	505
Ranchi..................	6	40,884	79	2	4	9	23	20	13	4	4	518
Warangol................	8	50,959	97	4	3	8	27	36	10	7	2	525

- Entry represents zero.

Source: 1970 Census of Population.

Exhibit IV-2-3. PRELIMINARY POPULATION COUNT: URBAN ENUMERATION AREAS BY SIZE GROUPS, FOR DISTRICTS IN RAJPUR PROVINCE: 1970

District	Urban population, 1 May 1970	Number of urban EA's 1970								Average number of persons per urban EA
		Total	With population--							
			Under 500	500 to 599	600 to 699	700 to 799	800 to 899	900 to 999	1,000 or more	
Total..............	164,914	175	7	13	16	24	43	35	37	942
Adoni.....................	7,120	7	-	-	-	-	-	2	5	1,017
Adjmer....................	99,480	103	6	8	9	17	33	15	15	966
Baroda....................	10,555	12	-	-	1	3	2	4	2	880
Bellary...................	5,994	6	-	-	-	-	1	3	2	999
Bhopal....................	2,005	2	-	-	-	-	-	1	1	1,002
Chanda....................	2,814	3	-	-	-	-	1	1	1	938
Chirmuri..................	3,313	4	-	1	-	1	-	1	1	828
Dabhor....................	1,327	1	-	-	-	-	-	-	1	1,327
Jaipur....................	683	1	-	-	1	-	-	-	-	683
Kanpur....................	3,917	4	-	-	-	-	2	1	1	979
Karur.....................	3,924	4	-	-	-	-	1	2	1	981
Kistna....................	1,428	2	-	1	-	-	-	1	-	714
Kolar.....................	782	1	-	-	-	1	-	-	-	782
Poona.....................	648	1	-	-	1	-	-	-	-	648
Ranchi....................	4,671	5	-	-	2	1	-	-	2	934
Warangol..................	16,253	19	1	3	2	1	3	4	5	855

- Entry represents zero.

Source: 1970 Census of Population.

Exhibit IV-2-4. PRELIMINARY POPULATION COUNT: RURAL ENUMERATION AREAS BY SIZE GROUPS, FOR THE PROVINCES: 1970

Province	Number of districts	Number of sub-districts	Rural population, 1 May 1970	Number of rural EA's 1970									Average number of rural EA's per district	Average number of persons per rural EA
				Total	With population--									
					Under 200	200 to 299	300 to 399	400 to 499	500 to 599	600 to 699	700 to 799	800 or more		
Total.......	[1] 171	1,093	6,090,387	11,826	274	780	1,921	3,274	2,715	1,490	839	533	69	515
Bolivar...........	8	25	104,994	221	16	31	32	42	44	28	17	11	28	475
Dewar.............	12	52	277,015	595	31	67	102	122	167	75	20	11	50	466
DuBois............	14	84	477,251	917	24	69	134	236	203	132	66	53	65	520
Hassam............	9	51	245,867	482	24	58	59	121	86	63	38	33	54	510
Liberto...........	12	110	639,981	1,288	16	80	247	352	292	183	79	39	107	497
Lopez.............	[1] 19	235	1,243,892	2,064	19	38	215	579	422	310	274	207	109	603
Lo-San-Tho........	11	53	240,086	538	22	49	146	179	69	29	31	13	49	446
Morgan............	12	85	492,982	980	11	69	165	276	235	141	59	24	82	503
Paris.............	18	46	255,112	583	32	95	107	157	109	53	24	6	32	438
Rajpur............	16	90	520,087	1,057	32	64	175	372	224	97	55	38	66	492
Rama..............	15	47	309,907	675	13	52	168	191	177	39	29	6	45	459
Tali..............	15	171	1,026,749	1,870	15	61	233	494	579	288	116	84	125	549
Valencia..........	10	44	256,464	556	19	47	138	153	108	52	31	8	56	461

[1] Excludes Calicut District which is entirely urban.

Source: 1970 Census of Population.

Exhibit IV-2-5. PRELIMINARY POPULATION COUNT: URBAN ENUMERATION AREAS BY SIZE GROUPS, FOR THE PROVINCES: 1970

Province	Urban population, 1 May 1970	Number of urban EA's 1970								Average number of persons per urban EA
		Total	With population--							
			Under 500	500 to 599	600 to 699	700 to 799	800 to 899	900 to 999	1,000 or more	
Total.......	3,284,165	3,110	67	100	337	659	859	651	437	1,056
Bolivar...........	45,998	42	1	2	3	4	10	14	8	1,095
Dewar.............	67,977	66	-	-	7	12	19	16	12	1,030
DuBois............	290,337	264	10	11	28	31	57	69	58	1,100
Hassam............	207,474	190	3	6	27	36	39	41	38	1,092
Liberto...........	334,810	337	9	18	42	51	83	68	66	993
Lopez.............	1,182,585	1,108	12	19	148	320	340	171	98	1,067
Lo-San-Tho........	75,900	74	2	3	6	11	22	19	11	1,026
Morgan............	216,249	210	4	5	16	31	48	62	44	1,030
Paris.............	37,871	38	1	3	5	8	7	8	6	997
Rajpur............	164,914	175	7	13	16	24	43	35	37	942
Rama..............	104,585	105	2	5	6	28	32	18	14	996
Tali..............	476,022	428	16	14	32	101	133	103	29	1,112
Valencia..........	79,443	73	-	1	1	2	26	27	16	1,088

- Entry represents zero.

Source: 1970 Census of Population.

Exhibit IV-2-6. ESTIMATED SAMPLE SIZE, FOR THE PROVINCES

Province	Population, 1 May 1970 (preliminary count)				PSU's		Housing units (estimated number)	
	Total for agriculture census (1)	Rural (2)	Small urban places (3)	Outskirts of large urban places (4)	Total (5)	In sample (6)	Total (7)	Listings in sample PSU's (8)
Provinces, total........	6,747,729	6,090,387	413,340	244,002	11,948	2,991	1,204,210	301,055
Bolivar......................	135,477	104,994	27,745	2,738	248	62	19,640	4,910
Dewar........................	313,778	277,015	28,960	7,803	542	136	46,840	11,710
DuBois.......................	541,432	477,251	42,475	21,706	916	229	94,305	23,575
Hassam.......................	286,346	245,867	23,453	17,026	531	133	41,500	10,375
Liberto......................	691,781	639,981	31,745	20,055	1,231	308	135,225	33,805
Lopez........................	1,381,114	1,243,892	61,714	75,508	2,345	586	276,225	69,055
Lo-San-Tho...................	258,317	240,086	5,398	12,833	498	125	39,630	9,910
Morgan.......................	528,833	492,982	14,558	21,293	951	238	99,720	24,930
Paris........................	286,014	255,112	29,160	1,742	546	137	42,145	10,535
Rajpur.......................	563,123	520,087	31,772	11,264	1,048	264	89,385	22,350
Rama.........................	362,480	309,907	41,901	10,672	670	168	55,030	13,760
Tali.........................	1,115,901	1,026,749	59,058	30,094	1,889	472	224,115	56,030
Valencia.....................	283,133	256,464	15,401	11,268	533	133	40,450	10,110

Province	All holdings within scope of agriculture census (estimated number)				Holdings in sample (estimated number)			
	Total (9)	Small (10)	Local Certainty (11)	National Certainty (12)	Total (13)	Small (14)	Local Certainty (15)	National Certainty (16)
Provinces, total........	1,008,970	977,490	27,880	3,600	71,680	61,100	6,980	3,600
Bolivar......................	17,855	16,780	955	120	1,410	1,050	240	120
Dewar........................	40,730	38,510	2,160	60	3,010	2,410	540	60
DuBois.......................	78,585	76,240	1,965	380	5,635	4,765	490	380
Hassam.......................	34,645	33,005	1,400	240	2,650	2,060	350	240
Liberto......................	110,615	108,850	1,600	165	7,360	6,795	400	165
Lopez........................	226,860	223,600	2,240	1,020	15,560	13,930	560	1,020
Lo-San-Tho...................	36,530	33,585	2,725	220	3,005	2,105	680	220
Morgan.......................	83,100	80,465	2,475	160	5,810	5,030	620	160
Paris........................	38,815	36,935	1,680	200	2,940	2,320	420	200
Rajpur.......................	77,855	73,935	3,520	400	5,905	4,620	885	400
Rama.........................	47,990	45,930	1,960	100	3,460	2,870	490	100
Tali.........................	180,890	176,935	3,595	360	12,315	11,050	905	360
Valencia.....................	34,500	32,720	1,605	175	2,620	2,045	400	175

Column 1. Sum of columns 2, 3, and 4.

Column 2. All EA's classified as rural.

Column 3. Urban places under 5,000 population.

Column 4. EA's outside the built-up area of urban places with population of 5,000 and over. Delineation of such EA's is based on judgment and knowledge of the area.

Column 5. Primary sampling units established for the 1971 Sample Census of Agriculture; roughly equivalent to EA's in the Population Census except that small EA's are combined and large EA's are subdivided.

Column 6. One-fourth of the total PSU's.

Column 7. Estimates based on the 1960 average number of persons per housing unit; by Province, this average ranges from approximately 5.0 to 7.0 persons.

Column 8. One-fourth of the total housing units that are in the sample PSU's.

Column 9. Estimates of holdings in 1971 assume the same relationship between listings and holdings that was found in the 1961 Sample Census of Agriculture, with adjustment for difference in size of holdings considered out-of-scope. By Province, this relationship ranges from about 80 percent to 92 percent.

Column 10. Holdings between 1/10 hectare and Local Certainty level.

Column 11. Holdings 50 to 499 hectares in Liberto, Lopez, Morgan, and Tali Provinces; 100 to 499 hectares in Bolivar, DuBois, Hassam, Lo-San-Tho, and Paris Provinces; and 200 to 499 hectares in Dewar, Rajpur, Rama, and Valencia Provinces.

Column 12. Holdings of 500 hectares or more or having specialized agricultural operations.

Column 13. Sum of columns 14, 15, and 16; total number of A-1 questionnaires to be filled.

Column 14. One-sixteenth of the estimate in column 10 (one-fourth of the small holdings within the sample PSU's).

Column 15. One-fourth of the estimate in column 11 (all the Local Certainty holdings in the sample PSU's).

Column 16. Same as figure in column 12; all National Certainty holdings are to be enumerated.

Exhibit IV-2-7. ESTIMATED SAMPLE SIZE, FOR RAJPUR PROVINCE

District	Population, 1 May 1970 (preliminary counts)				PSU'S		Housing units (estimated number)	
	Total for agriculture census (1)	Rural (2)	Small urban places (3)	Outskirts of large urban places (4)	Total (5)	In sample (6)	Total (7)	Listings in sample PSU's (8)
Total..................	563,123	520,087	31,772	11,264	1,048	264	89,385	22,350
Adoni-Bellary................	48,780	46,157	-	2,623	87	22	7,740	1,935
Ajmer........................	54,766	47,445	2,471	4,850	96	24	8,695	2,170
Baroda.......................	46,618	41,476	3,789	1,353	88	22	7,400	1,850
Bhophal......................	32,128	30,123	2,005	-	69	17	5,100	1,275
Chanda.......................	47,749	44,935	2,814	-	86	22	7,580	1,895
Chirmuri.....................	53,002	49,689	3,313	-	92	23	8,415	2,105
Dabhor-Poona.................	40,414	38,439	1,975	-	78	20	6,415	1,605
Jaipur-Kistna................	27,741	25,630	2,111	-	60	15	4,405	1,100
Kanpur.......................	35,138	31,221	3,917	-	68	17	5,575	1,395
Karur........................	37,872	33,948	3,924	-	73	18	6,010	1,505
Kolar........................	39,963	39,181	782	-	74	19	6,345	1,585
Ranchi.......................	45,555	40,884	4,671	-	83	21	7,230	1,810
Warangol.....................	53,397	50,959	-	2,438	94	24	8,475	2,120

District	All holdings within scope of agriculture census (estimated number)				Holdings in sample (estimated number)			
	Total (9)	Small (10)	Local Certainty (11)	National Certainty (12)	Total (13)	Small (14)	Local Certainty (15)	National Certainty (16)
Total..................	77,855	73,935	3,520	400	5,905	4,620	885	400
Adoni-Bellary................	6,745	6,205	480	60	570	390	120	60
Ajmer........................	7,570	7,270	290	10	540	460	70	10
Baroda.......................	6,445	6,070	340	35	500	380	85	35
Bhophal......................	4,440	4,230	190	20	335	265	50	20
Chanda.......................	6,600	6,350	230	20	475	395	60	20
Chirmuri.....................	7,330	7,065	240	25	525	440	60	25
Dabhor-Poona.................	5,585	5,135	400	50	470	320	100	50
Jaipur-Kistna................	3,835	3,520	260	55	340	220	65	55
Kanpur.......................	4,860	4,680	150	30	360	290	40	30
Karur........................	5,235	5,000	220	15	380	310	55	15
Kolar........................	5,525	5,320	180	25	400	330	45	25
Ranchi.......................	6,300	6,070	210	20	455	380	55	20
Warangol.....................	7,385	7,020	330	35	555	440	80	35

- Entry represents zero.

Column 1. Sum of columns 2, 3, and 4.

Column 2. All EA's classified as rural.

Column 3. Urban places under 5,000 population.

Column 4. EA's outside the built-up area of urban places with population of 5,000 and over. Delineation of such EA's is based on judgment and knowledge of the area.

Column 5. Primary sampling units established for the 1971 Sample Census of Agriculture; roughly equivalent to EA's in the Population Census except that small EA's are combined and large EA's are subdivided.

Column 6. One-fourth of the total PSU's.

Column 7. Estimates based on the 1960 average number of persons per housing unit for Rajpur Province, 6.3 persons.

Column 8. One-fourth of the total housing units that are in the sample PSU's.

Column 9. Estimates of holdings in 1971 assume the same relationship between listings and holdings (about 88 percent) that was found in the 1961 Sample Census of Agriculture, with adjustment for difference in size of holdings out-of-scope for Rajpur Province.

Column 10. Holdings between 1/10 hectare and Local Certainty level.

Column 11. Holdings 200 to 499 hectares.

Column 12. Holdings of 500 hectares or more or having specialized agricultural operations.

Column 13. Sum of columns 14, 15, and 16; total number of A-1 questionnaires to be filled.

Column 14. One-sixteenth of the estimate in column 10 (one-fourth of the small holdings within the sample PSU's).

Column 15. One-fourth of the estimate in column 11 (all the Local Certainty holdings in the sample PSU's).

Column 16. Same as figure in column 12; all National Certainty holdings are to be enumerated.

Exhibit IV-2-8. SIMPLE METHOD FOR OPTIMIZING SAMPLE DESIGN

Once the cost factors have been determined, an approximately optimum sample design for the average district can be found. If enough data on costs and variability were available, very complicated mathematical methods could be used to determine the sample design. Such methods are not likely to result in a very different design for the Agrostan Sample Census of Agriculture, however, than the simple method which is discussed below.

From statistical theory we know that the coefficient of variation (V), used to compute the relative standard error of a proportion, is 1 when P = .50, since $V = \sqrt{\frac{Q}{P}}$. The coefficient of variation is only about 1.5 when P is as small as .3. For larger values of P (larger than .50), V is smaller. Other types of estimates such as averages and aggregates will have much larger coefficients of variation than proportions, when all types of holdings are considered, because of greater differences between holdings. However, when the National Certainty holdings are placed in a separate universe, the coefficient of variation for the remaining small holdings is probably close to 1 for the most important characteristics. Therefore, it seems reasonable to base the sample size for the average district on characteristics with a coefficient of variation of 1. It was shown in section 5.1 of chapter 2 (in Unit IV of the case study) that the sample size needed to estimate this type of characteristic with a coefficient of variation of 5% is 400 holdings when simple random sampling is used.

At this point, some estimate must be made of the effects of the various refinements which will be included in the design. Let us assume that the stratification of the PSU's, the inclusion of Local Certainty holdings and National Certainty holdings, and the stratification of the holdings by size within the sample PSU's will result in the required sample size for the small holdings being reduced to about 200 for simple random sampling. With cluster sampling this number will be increased depending on the intraclass correlation factor (δ) and the average number of sample units per sample cluster ($\bar{n}$).

Both δ and $\bar{n}$ can vary over a relatively large range. Moreover, the value of m (the number of PSU's required) will be different for each value of $\bar{n}$ or δ . The procedure which will be followed here is to assume a value of δ and then to consider alternative values of $\bar{n}$ and the resulting values of m, together with the cost factors given in section 6.1. The values of m and $\bar{n}$ which provide the desired reliability at lowest cost will determine the approximately optimum design for the assumed value of δ .

For values of δ which are lower than the assumed value, the sample size will be large enough. For values of δ that are larger than the assumed value, it is probable that the sample size will be too small for the desired reliability, but the loss in reliability will likely not be as great as it appears. With high values of δ, the stratification of PSU's is more effective and the loss in reliability from the use of a small sample size is partially compensated. Therefore, if we assume a value for δ which is representative of most of the important characteristics for district estimates, the optimum design for these characteristics should be reasonably appropriate for characteristics with smaller or larger values of δ.

In our earlier consideration of required sample size, a value of .05 for δ was assumed. This value should be quite representative of many characteristics in Agrostan, when the average size of the PSU's ($\bar{N}$) is about 80 holdings. Let us then use $\delta = .05$ to consider alternative sample designs for the Agrostan Sample Census of Agriculture.

The following table gives the number of PSU's (m) and total variable costs for different average sizes of sample within the PSU's (different values for $\bar{n}$). The table also shows the total sample size ($m\bar{n}$) required in each case. We can now choose the sample design which will cost the least while providing the desired reliability using PSU's with intraclass correlation of about .05 for these characteristics. For the table, the reliability is assumed to be the same for each sample design considered. Alternatively,

Exhibit IV-2-8. SIMPLE METHOD FOR OPTIMIZING SAMPLE DESIGN--Continued

we could have held the variable cost constant and considered the sampling error for each design; the purpose would have been to minimize the sampling error for a fixed cost.

TOTAL VARIABLE COSTS FOR ALTERNATIVE TWO-STAGE SAMPLE DESIGN

(When δ is .05, C_1 is \$40, and C_2 is \$2)

Sample holdings per PSU ($\bar{n}$)	Number of sample PSU's (m)	Total number of sample holdings ($m\bar{n}$)	Total variable costs ($C_1 m - C_2 m\bar{n}$)
1	200	200	\$8,400
4	57	230	2,740
8	34	270	1,900
12	26	310	1,660
16	22	350	1,580
20	19	380	1,520
24	18	430	1,580
28	17	470	1,620

From the table we can determine the optimum sample design when δ is .05, C_1 is \$40, and C_2 is \$2. When $\bar{n}$ is 1, the design is nearly the same as for simple random sampling. This design is unquestionably inefficient compared to a design with some clustering; therefore it is deleted from further consideration.

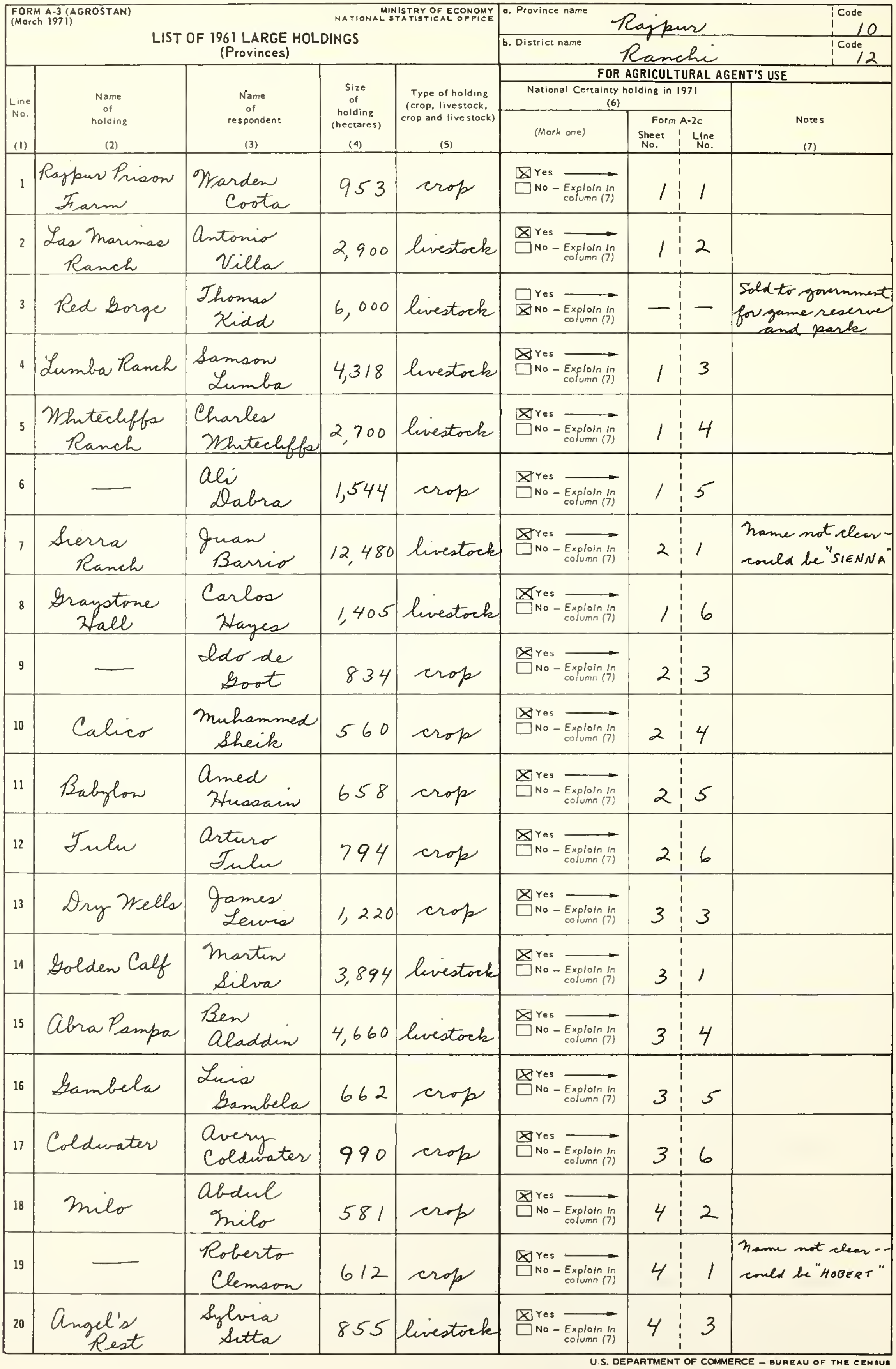
When $\bar{n}$ is 20, the number of sample PSU's required is 19. This design is least costly of all the alternatives. (The number of PSU's for the design was computed to the nearest whole PSU; actually the design requires 19.5 PSU's.) If 390 holdings are selected from 20 PSU's instead of 19, the cost is about the same as the designs where $\bar{n}$ is 16 or $\bar{n}$ is 24. Therefore, all three of these designs can be considered optimum and any one of them could be chosen for the Agrostan sample design.

The design where $\bar{n}$ is 20 and m is 20 was chosen because the selection of the sample in this design is more convenient than in the other two. The average number of PSU's per district is about 80 and the number of holdings within the PSU's averages about 80 to 85. Thus, a 1-in-4 sample of PSU's from each district and a 1-in-4 sample of holdings from each sample PSU will provide enough sample holdings and result in sampling rates (and weights) which are easy to apply. This is an important consideration when the sampling of holdings is selected by field personnel, as is the case in Agrostan. The misapplication of a more complex sampling interval could easily result in a serious bias.

A sample of 20 holdings from each of 20 PSU's is therefore approximately optimum when δ is .05. How well is a characteristic with δ = .10 estimated from this sample? The reader will recall that the coefficient of variation $V_{x'}$ of an estimate is $\frac{\sigma_{\bar{x}'}}{\bar{X}}$ and its square, the relative variance of an estimate is $V^2_{x'} = \frac{\sigma^2_{\bar{x}'}}{\bar{X}^2}$. With the assumptions used in Agrostan, $V^2_{x'} = (.05)^2$. This was determined by multiplying $\frac{\sigma^2_{\bar{x}'}}{\bar{X}^2}$ for a simple random sample by a factor $(1 + \delta(\bar{n} - 1))$. When δ = .05 and $\bar{n}$ = 20, this factor is 1.95; when δ is .1 and $\bar{n}$ is 20, the factor is 2.90. Thus, the $V^2_{x'}$ for the case when δ is .1 is $\frac{2.90}{1.95}$ or 1.49 times the $V^2_{x'}$ when δ is .05. The coefficient of variation $V_{x'}$ when δ is .1 is approximately $\sqrt{1.49}\ V_{x'}$ or 1.22 $V_{x'}$ when δ = .05. The sample of 400 holdings selected from 20 PSU's, which would provide estimates of characteristics with a $V_{x'}$ of .05 when δ = .05, would provide estimates with a $V_{x'}$ = 1.22 (.05) or .06 when δ is .10. We can conclude, therefore, that a moderate misjudgment in the size of the intraclass correlation coefficient will not normally result in a serious loss in reliability.

The assumptions of a coefficient of variation V = 1 and an intraclass correlation coefficient δ = .05, were chosen for conditions which exist in Agrostan. In many countries, one or both of these factors may be much larger; if so, a sample larger than 400 holdings would be needed. Alternatively a $V_{x'}$ larger than .05 for the important characteristics might be acceptable.

Exhibit IV-3-1. LIST OF 1961 LARGE HOLDINGS (PROVINCES), FORM A-3, FOR RANCHI DISTRICT IN RAJPUR PROVINCE



SHEET 1 OF 2 SHEETS

FORM A-3 (AGROSTAN)
(March 1971)

MINISTRY OF ECONOMY
NATIONAL STATISTICAL OFFICE

LIST OF 1961 LARGE HOLDINGS
(Provinces)

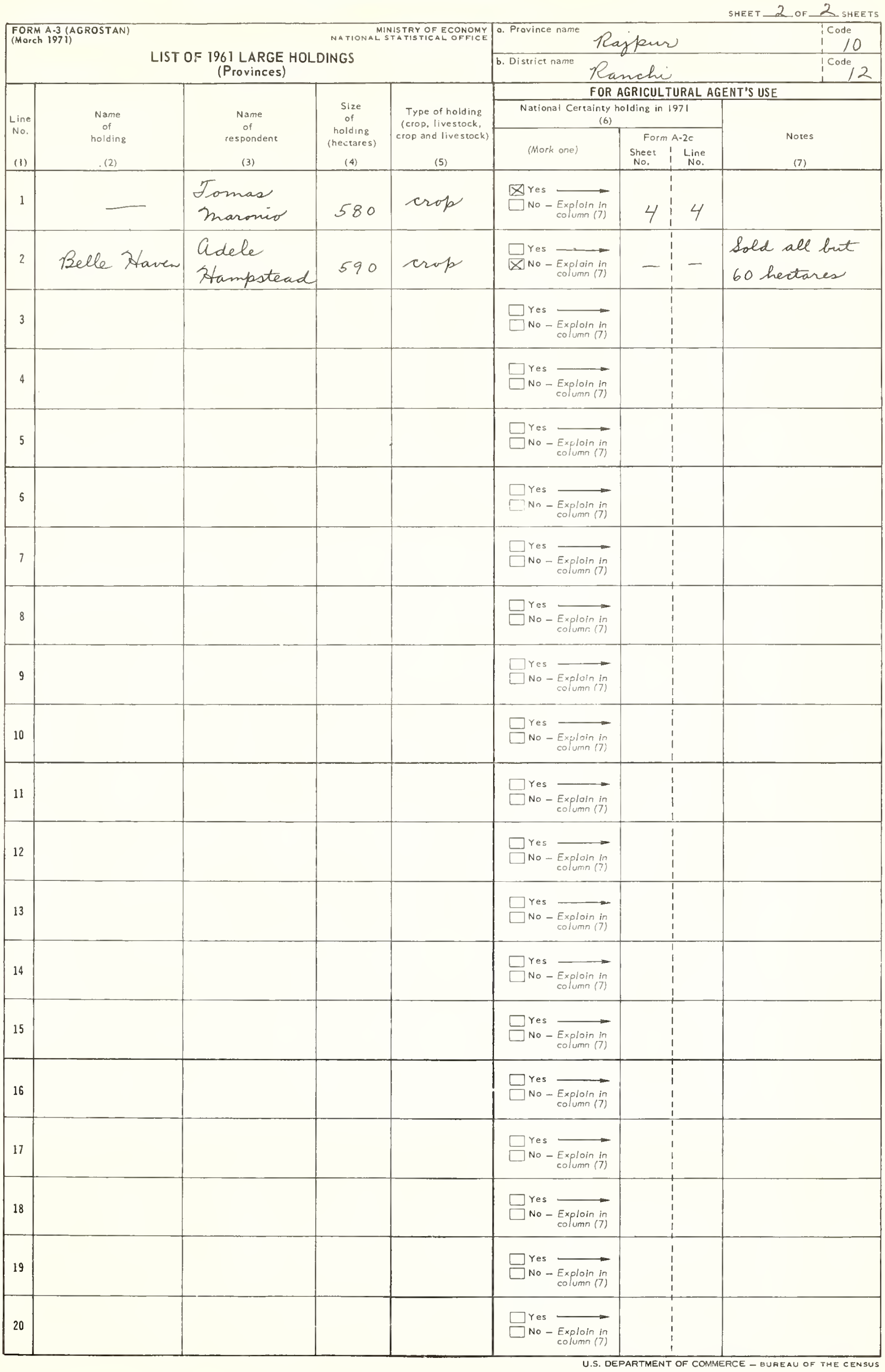
a. Province name Rajpur Code 10

b. District name Ranchi Code 12

					FOR AGRICULTURAL AGENT'S USE			
Line No. (1)	Name of holding (2)	Name of respondent (3)	Size of holding (hectares) (4)	Type of holding (crop, livestock, crop and livestock) (5)	National Certainty holding in 1971 (6) (Mark one)	Form A-2c Sheet No.	Form A-2c Line No.	Notes (7)
1	Rajpur Prison Farm	Warden Coota	953	crop	☒ Yes → ☐ No – Explain in column (7)	1	1	
2	Las Marimas Ranch	Antonio Villa	2,900	livestock	☒ Yes → ☐ No – Explain in column (7)	1	2	
3	Red Gorge	Thomas Kidd	6,000	livestock	☐ Yes → ☒ No – Explain in column (7)	—	—	Sold to government for game reserve and parks
4	Lumba Ranch	Samson Lumba	4,318	livestock	☒ Yes → ☐ No – Explain in column (7)	1	3	
5	Whitecliffs Ranch	Charles Whitecliffs	2,700	livestock	☒ Yes → ☐ No – Explain in column (7)	1	4	
6	—	Ali Dabra	1,544	crop	☒ Yes → ☐ No – Explain in column (7)	1	5	
7	Sierra Ranch	Juan Barrio	12,480	livestock	☒ Yes → ☐ No – Explain in column (7)	2	1	name not clear – could be "SIENNA"
8	Graystone Hall	Carlos Hayes	1,405	livestock	☒ Yes → ☐ No – Explain in column (7)	1	6	
9	—	Ido de Goot	834	crop	☒ Yes → ☐ No – Explain in column (7)	2	3	
10	Calico	Muhammed Sheik	560	crop	☒ Yes → ☐ No – Explain in column (7)	2	4	
11	Babylon	Amed Hussain	658	crop	☒ Yes → ☐ No – Explain in column (7)	2	5	
12	Tulu	Arturo Tulu	794	crop	☒ Yes → ☐ No – Explain in column (7)	2	6	
13	Dry Wells	James Lewis	1,220	crop	☒ Yes → ☐ No – Explain in column (7)	3	3	
14	Golden Calf	Martin Silva	3,894	livestock	☒ Yes → ☐ No – Explain in column (7)	3	1	
15	Abra Pampa	Ben Aladdin	4,660	livestock	☒ Yes → ☐ No – Explain in column (7)	3	4	
16	Gambela	Luis Gambela	662	crop	☒ Yes → ☐ No – Explain in column (7)	3	5	
17	Coldwater	Avery Coldwater	990	crop	☒ Yes → ☐ No – Explain in column (7)	3	6	
18	Milo	Abdul Milo	581	crop	☒ Yes → ☐ No – Explain in column (7)	4	2	
19	—	Roberto Clemson	612	crop	☒ Yes → ☐ No – Explain in column (7)	4	1	name not clear -- could be "HOBERT"
20	Angel's Rest	Sylvia Sitta	855	livestock	☒ Yes → ☐ No – Explain in column (7)	4	3	

U.S. DEPARTMENT OF COMMERCE – BUREAU OF THE CENSUS

Exhibit IV-3-1. *LIST OF 1961 LARGE HOLDINGS (PROVINCES), FORM A-3, FOR RANCHI DISTRICT IN RAJPUR PROVINCE--Continued*



SHEET 2 OF 2 SHEETS

FORM A-3 (AGROSTAN)
(March 1971)

MINISTRY OF ECONOMY
NATIONAL STATISTICAL OFFICE

LIST OF 1961 LARGE HOLDINGS
(Provinces)

a. Province name Rajpur Code 10
b. District name Ranchi Code 12

FOR AGRICULTURAL AGENT'S USE

Line No. (1)	Name of holding (2)	Name of respondent (3)	Size of holding (hectares) (4)	Type of holding (crop, livestock, crop and livestock) (5)	National Certainty holding in 1971 (6) (Mark one)	Form A-2c Sheet No.	Form A-2c Line No.	Notes (7)
1	—	Tomas Maronio	580	crop	☒ Yes → ☐ No – Explain in column (7)	4	4	
2	Belle Haven	Adele Hampstead	590	crop	☐ Yes → ☒ No – Explain in column (7)	—	—	Sold all but 60 hectares
3					☐ Yes → ☐ No – Explain in column (7)			
4					☐ Yes → ☐ No – Explain in column (7)			
5					☐ Yes → ☐ No – Explain in column (7)			
5					☐ Yes → ☐ No – Explain in column (7)			
7					☐ Yes → ☐ No – Explain in column (7)			
8					☐ Yes → ☐ No – Explain in column (7)			
9					☐ Yes → ☐ No – Explain in column (7)			
10					☐ Yes → ☐ No – Explain in column (7)			
11					☐ Yes → ☐ No – Explain in column (7)			
12					☐ Yes → ☐ No – Explain in column (7)			
13					☐ Yes → ☐ No – Explain in column (7)			
14					☐ Yes → ☐ No – Explain in column (7)			
15					☐ Yes → ☐ No – Explain in column (7)			
16					☐ Yes → ☐ No – Explain in column (7)			
17					☐ Yes → ☐ No – Explain in column (7)			
18					☐ Yes → ☐ No – Explain in column (7)			
19					☐ Yes → ☐ No – Explain in column (7)			
20					☐ Yes → ☐ No – Explain in column (7)			

U.S. DEPARTMENT OF COMMERCE – BUREAU OF THE CENSUS

Exhibit IV-3-2. 1971 NATIONAL CERTAINTY LISTING (PROVINCES), FORM A-2c, FOR RANCHI DISTRICT IN RAJPUR PROVINCE.

SHEET 1 OF 4 SHEETS

CONFIDENTIAL – This inquiry is required by law. All information will be held strictly confidential.

FORM A-2c (AGROSTAN)
(March 1971)

MINISTRY OF ECONOMY
NATIONAL STATISTICAL OFFICE

NATIONAL CERTAINTY LISTING
1971 CENSUS OF AGRICULTURE
(Provinces)

FOR PCO USE
a. Supervisor

b. Province name: RAJPUR — Code: 10

c. District name: RANCHI — Code: 12

FOR DISTRICT AGRICULTURAL AGENT'S USE →

d. List prepared by: William Manno

e. Date prepared: 12 August 1971

Line No. (1)	Name and mailing address of holding (2)	Location of holding (3)	Name of holder and location where holder can be reached (4)	Total number of hectares in holding (Approximate) (5)	Type of holding (cattle, cotton, hogs and cotton, etc.) (6)	Preliminary A-1c No. (7)	A-1c mailed (8)	FOR SUPERVISOR'S USE: A-1c assigned (9)	FOR SUPERVISOR'S USE: Date A-1c – Completed (10)	FOR SUPERVISOR'S USE: Date A-1c – Approved (11)	FOR SUPERVISOR'S USE: Date A-1c – Sent to PCO (12)	FOR PCO USE: Date A-1c – Received (13)	FOR PCO USE: Date A-1c – Approved (14)	FOR PCO USE: Date A-1c – Sent to NSO (15)	FOR NSO USE: Date A-1c received (16)	Notes (17)
1	Name: Rajpur Prison Mailing address: P.O. Box 82 Adunko	Road or highway: Adoni Road Nearest hamlet or urban place: Adunko Directions: 4 kilometers northwest of Adunko	Name: Warden Coota Location: Same as 3	1,100	cotton	701	☐ Yes ☐ No	To Date								
2	Name: Las Marismas Ranch Mailing address: P.O. Box 319 Budsar	Road or highway: Conocoto Road Nearest hamlet or urban place: Budsar Directions: 4½ km northwest of junction of Conocoto and Adunko Roads	Name: Antonio Villa Location: Same as 3	3,300	sheep	702	☐ Yes ☐ No	To Date								Hired manager for Norman Cortez who lives in Georgetown
3	Name: Lumba Ranch Mailing address: P.O. Box 104 Terjun	Road or highway: Beela Trail Nearest hamlet or urban place: Terjun Directions: 4 km southwest on Lutta Trail to Beela Trail. 2 km southeast on Beela Trail	Name: Samson Lumba Location: Same as 3	4,450	cattle	703	☐ Yes ☐ No	To Date								
4	Name: Whitecliffs Ranch Mailing address: P.O. Box 412 Jebul	Road or highway: Kolar Road Nearest hamlet or urban place: Jebul Directions: 3½ km north on Holon Road, 5 km northeast on Kolar Road	Name: Charles Whitecliffs Location: Same as 3	2,350	sheep	704	☐ Yes ☐ No	To Date								
5	Name: — Mailing address: P.O. Box 37 Tepua	Road or highway: Corda Trail Nearest hamlet or urban place: Tepua Directions: 7 km northeast of Tepua on Corda Trail	Name: Ali Dabbra Location: Same as 3	1,650	cotton	705	☐ Yes ☐ No	To Date								
6	Name: Greystone Hall Mailing address: P.O. Box 16 Jebul	Road or highway: Holon Road Nearest hamlet or urban place: Jebul Directions: 4 km southeast of Jebul, 1 km east of Holon Road	Name: Clifford Hayes Location: Same as 3	1,200	cattle	706	☐ Yes ☐ No	To Date								Land sold to Clifford Hayes in 1965

COPY DISTRIBUTION: BUFF – Supervisor SALMON – PCO WHITE – NSO

U.S. DEPARTMENT OF COMMERCE – BUREAU OF THE CENSUS

Exhibit IV-3-2. 1971 NATIONAL CERTAINTY LISTING (PROVINCES), FORM A-2c, FOR RANCHI DISTRICT IN RAJPUR PROVINCE--Continued

SHEET 2 OF 4 SHEETS

CONFIDENTIAL – This inquiry is required by law. All information will be held strictly confidential.

FORM A-2c (AGROSTAN)
(March 1971)

MINISTRY OF ECONOMY
NATIONAL STATISTICAL OFFICE

NATIONAL CERTAINTY LISTING
1971 CENSUS OF AGRICULTURE
(Provinces)

FOR PCO USE
a. Supervisor

b. Province name RAJPUR Code 10

c. District name RANCHI Code 12

FOR DISTRICT AGRICULTURAL AGENT'S USE ⟶ d. List prepared by William Manns

e. Date prepared 12 August 1971

Line No.	Name and mailing address of holding	Location of holding	Name of holder and location where holder can be reached	Total number of hectares in holding (Approximate)	Type of holding (cattle, cotton, hogs and cotton, etc.)	Preliminary A-1c No.	A-1c mailed	A-1c assigned	FOR SUPERVISOR'S USE – Date A-1c – Completed	Approved	Sent to PCO	FOR PCO USE – Date A-1c – Received	Approved	Sent to NSO	FOR NSO USE – Date A-1c received	Notes
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)
1	Name Sienna Ranch Mailing address P.O. Box 66 Pusan	Road or highway Lutt Trail Nearest hamlet or urban place Pusan Directions 7 km east on Meseta Road, 2 km due north on Lutt Trail	Name Simon Barrio Carlo Barrio Location Same as 3	12,600	cattle	707	☐ Yes ☐ No	To Date								Father died, sons are partners
2	Name Finn Mailing address P.O. Box 81 Pusan	Road or highway Unnamed trail Nearest hamlet or urban place Pusan Directions 5 km northwest on Adoni Road, 2 km northeast on unnamed trail	Name Barton Finn Location Same as 3	940	wheat	708	☐ Yes ☐ No	To Date								
3	Name — Mailing address P.O. Box 46 Hazem	Road or highway Memmo Road Nearest hamlet or urban place Hazem Directions 7 km southwest on Memmo Road	Name Ido de Goot Location Same as 3	910	wheat	709	☐ Yes ☐ No	To Date								
4	Name Calico Mailing address P.O. Box 49 Pusan	Road or highway Willow Road Nearest hamlet or urban place Pusan Directions 8 km southwest on Meseta Road, 3 km northwest on Killat Road, 3 km northwest on Willow Road	Name Muhammad Sheik Location Same as 3	590	cotton	710	☐ Yes ☐ No	To Date								
5	Name Babylon Mailing address P.O. Box 39 Pusan	Road or highway Unnamed trail Nearest hamlet or urban place Pusan Directions 8 km southwest on Meseta Road, 3 km northwest on Killat Road, 2 km east on unnamed trail	Name Amed Hussain Location Same as 3	720	cotton	711	☐ Yes ☐ No	To Date								
6	Name Tulu Mailing address P.O. Box 27 Pusan	Road or highway Meseta Road Nearest hamlet or urban place Pusan Directions 1 km due east on Meseta Road	Name Arturo Tulu Location Law office in Pusan on main street next to general store	780	cotton	712	☐ Yes ☐ No	To Date								

COPY DISTRIBUTION: BUFF – Supervisor SALMON – PCO WHITE – NSO

U.S. DEPARTMENT OF COMMERCE – BUREAU OF THE CENSUS

Exhibit IV-3-2. 1971 NATIONAL CERTAINTY LISTING (PROVINCES), FORM A-2c, FOR RANCHI DISTRICT IN RAJPUR PROVINCE--Continued

SHEET 3 OF 4 SHEETS

CONFIDENTIAL – This inquiry is required by law. All information will be held strictly confidential.

FORM A-2c (AGROSTAN)
(March 1971)

MINISTRY OF ECONOMY
NATIONAL STATISTICAL OFFICE

NATIONAL CERTAINTY LISTING
1971 CENSUS OF AGRICULTURE
(Provinces)

FOR PCO USE
a. Supervisor

b. Province name RAJPUR | Code 10

c. District name RANCHI | Code 12

FOR DISTRICT AGRICULTURAL AGENT'S USE ——→ d. List prepared by William Manno

e. Date prepared 12 August 1971

									FOR SUPERVISOR'S USE			FOR PCO USE			FOR NSO USE	
									Date A-1c –			Date A-1c –				
Line No. (1)	Name and mailing address of holding (2)	Location of holding (3)	Name of holder and location where holder can be reached (4)	Total number of hectares in holding (*Approximate*) (5)	Type of holding (cattle, cotton, hogs and cotton, etc.) (6)	Preliminary A-1c No. (7)	A-1c mailed (8)	A-1c assigned (9)	Completed (10)	Approved (11)	Sent to PCD (12)	Received (13)	Approved (14)	Sent to NSO (15)	Date A-1c received (16)	Notes (17)
1	Name Golden Calf Mailing address P.O. Box 97 Semerky	Road or highway Bilo Road Nearest hamlet or urban place Semerky Directions 6 km due west on Meseta Road, 5 km southwest on Bilo Road	Name William Silva Martin Silva Location Same as 3	3,890	cattle	713	☐ Yes ☐ No	To Date								
2	Name Tailsman Mailing address P.O. Box 73 Tepua	Road or highway Sur Road Nearest hamlet or urban place Tepua Directions 1 km east on Meseta Road, 2 km south on Sur Road	Name Ghulam Kafta Location Doctor's office in Tepua on main road	1,740	cattle	714	☐ Yes ☐ No	To Date								
3	Name Dry Wells Mailing address P.O. Box 61 Tepua	Road or highway Unnamed trail Nearest hamlet or urban place Tepua Directions 9 km east on Meseta Road, 1 km south on unnamed trail	Name James Lewis Location Same as 3	1,410	wheat	715	☐ Yes ☐ No	To Date								
4	Name Abra Pampa Mailing address P.O. Box 39 Kigogo	Road or highway Hilo Trail Nearest hamlet or urban place Kigogo Directions 4 km east on Warangol Pass Road, 2 km north on Hilo Trail	Name Genji Aladdin Location Same as 3	4,920	cattle	716	☐ Yes ☐ No	To Date								Father died in 1964, son Genji inherited ranch
5	Name Gambela Mailing address P.O. Box 44 Kigogo	Road or highway Warangol Pass Road Nearest hamlet or urban place Kigogo Directions 6 km west on Warangol Pass Road	Name Luis Gambela Location Same as 3	780	wheat	717	☐ Yes ☐ No	To Date								
6	Name Coldwater Mailing address P.O. Box 9 Piedras	Road or highway Holon Road Nearest hamlet or urban place Piedras Directions 2 km north on Holon Road	Name Avery Coldwater Location Same as 3	805	wheat	718	☐ Yes ☐ No	To Date								

COPY DISTRIBUTION: BUFF – Supervisor SALMON – PCD WHITE – NSO

U.S. DEPARTMENT OF COMMERCE – BUREAU OF THE CENSUS

Exhibit IV-3-2. 1971 NATIONAL CERTAINTY LISTING (PROVINCES), FORM A-2c, FOR RANCHI DISTRICT IN RAJPUR PROVINCE--Continued

SHEET 4 OF 4 SHEETS

CONFIDENTIAL – This inquiry is required by law. All information will be held strictly confidential.

FORM A-2c (AGROSTAN)
(March 1971)

MINISTRY OF ECONOMY
NATIONAL STATISTICAL OFFICE

NATIONAL CERTAINTY LISTING
1971 CENSUS OF AGRICULTURE
(Provinces)

FOR PCO USE

a. Supervisor

b. Province name RAJPUR Code 10

c. District name RANCHI Code 12

FOR DISTRICT AGRICULTURAL AGENT'S USE ⟶ d. List prepared by William Manno

e. Date prepared 12 August 1971

Line No.	Name and mailing address of holding	Location of holding	Name of holder and location where holder can be reached	Total number of hectares in holding (Approximate)	Type of holding (cattle, cotton, hogs and cotton, etc.)	Preliminary A-1c No.	A-1c mailed	FOR SUPERVISOR'S USE				FOR PCO USE			FOR NSO USE	Notes
								A-1c assigned	Date A-1c –			Date A-1c –			Date A-1c received	
									Completed	Approved	Sent to PCO	Received	Approved	Sent to NSO		
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)
1	Name — Mailing address P.O. Box 85 Piedras	Road or highway Pana Trail Nearest hamlet or urban place Piedras Directions 10 km west on Warangol Pass Road, 1 km north on Pana Trail	Name Herbert Clemson Location Same as 3	690	wheat	719	☐ Yes ☐ No	To Date								
2	Name Milo Mailing address P.O. Box 59 Pusan	Road or highway Milo Trail Nearest hamlet or urban place Pusan Directions 5 km west on Meseta Road, 3 km south on Milo Trail	Name Abdul Milo Location Same as 3	640	wheat	720	☐ Yes ☐ No	To Date								
3	Name Angel's Rest Mailing address P.O. Box 47 Pusan	Road or highway Meseta Road Nearest hamlet or urban place Pusan Directions 13 km west on Meseta Road	Name Juan Sitta Location Same as 3	960	sheep	721	☐ Yes ☐ No	To Date									Son came of age in 1968, ranch was turned over to him.
4	Name — Mailing address P.O. Box 23 Pusan	Road or highway Milo Trail Nearest hamlet or urban place Pusan Directions 5 km west on Meseta Road, 10 km south on Milo Trail, 7 km south of Milo holding	Name Tomas Maronio Location Same as 3	560	cotton	722	☐ Yes ☐ No	To Date								
5	Name Balleau Mailing address P.O. Box 54 Piedras	Road or highway Cisco Road Nearest hamlet or urban place Piedras Directions 2 km west on Warangol Pass Road, 6 km southwest on Cisco Road	Name Andreas Maronio Location Same as 3	630	cotton	723	☐ Yes ☐ No	To Date								
6	Name Mailing address	Road or highway Nearest hamlet or urban place Directions	Name Location				☐ Yes ☐ No	To Date								

COPY DISTRIBUTION: BUFF – Supervisor SALMON – PCO WHITE – NSO

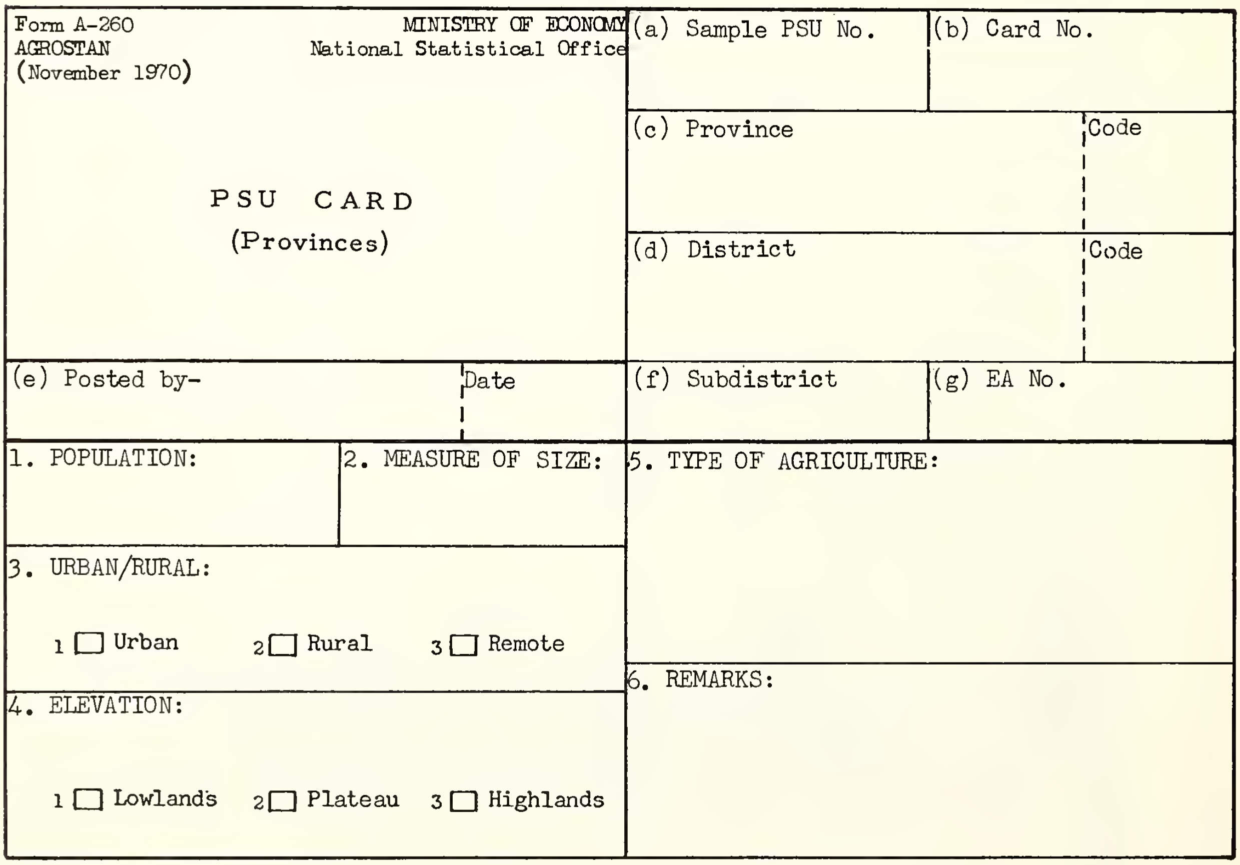
U.S. DEPARTMENT OF COMMERCE – BUREAU OF THE CENSUS

Exhibit IV-3-3. *PRELIMINARY COUNT: NUMBER AND POPULATION OF URBAN PLACES, BY SIZE OF PLACE, FOR THE PROVINCES: 1970*

Size group	Urban places		Urban population	
	Number	Percent	Number	Percent
Total	239	100.0	3,284,165	100.0
Urban places with population—				
Under 2,000	29	12.1	33,948	1.0
2,000 to 4,999	117	49.0	379,392	11.5
5,000 to 9,999	53	22.2	382,403	11.6
10,000 to 19,999	24	10.0	313,734	9.6
20,000 to 29,999	3	1.3	71,438	2.2
30,000 to 39,999	2	0.8	71,741	2.2
40,000 to 49,999	1	0.4	41,779	1.3
50,000 to 99,999	4	1.7	302,191	9.2
100,000 or more	6	2.5	1,687,539	51.4

Source: 1970 Census of Population for the Provinces.

Exhibit IV-3-4. *PSU CARD (PROVINCES), FORM A-260*



Form A-260
AGROSTAN
(November 1970)

MINISTRY OF ECONOMY
National Statistical Office

PSU CARD
(Provinces)

(a) Sample PSU No.
(b) Card No.
(c) Province | Code
(d) District | Code
(e) Posted by- | Date
(f) Subdistrict
(g) EA No.

1. POPULATION:
2. MEASURE OF SIZE:
3. URBAN/RURAL:
1 ☐ Urban 2 ☐ Rural 3 ☐ Remote
4. ELEVATION:
1 ☐ Lowlands 2 ☐ Plateau 3 ☐ Highlands
5. TYPE OF AGRICULTURE:
6. REMARKS:

Exhibit IV-3-5. MAP OF CORDOBA CITY IN WARANGOL DISTRICT, RAJPUR PROVINCE

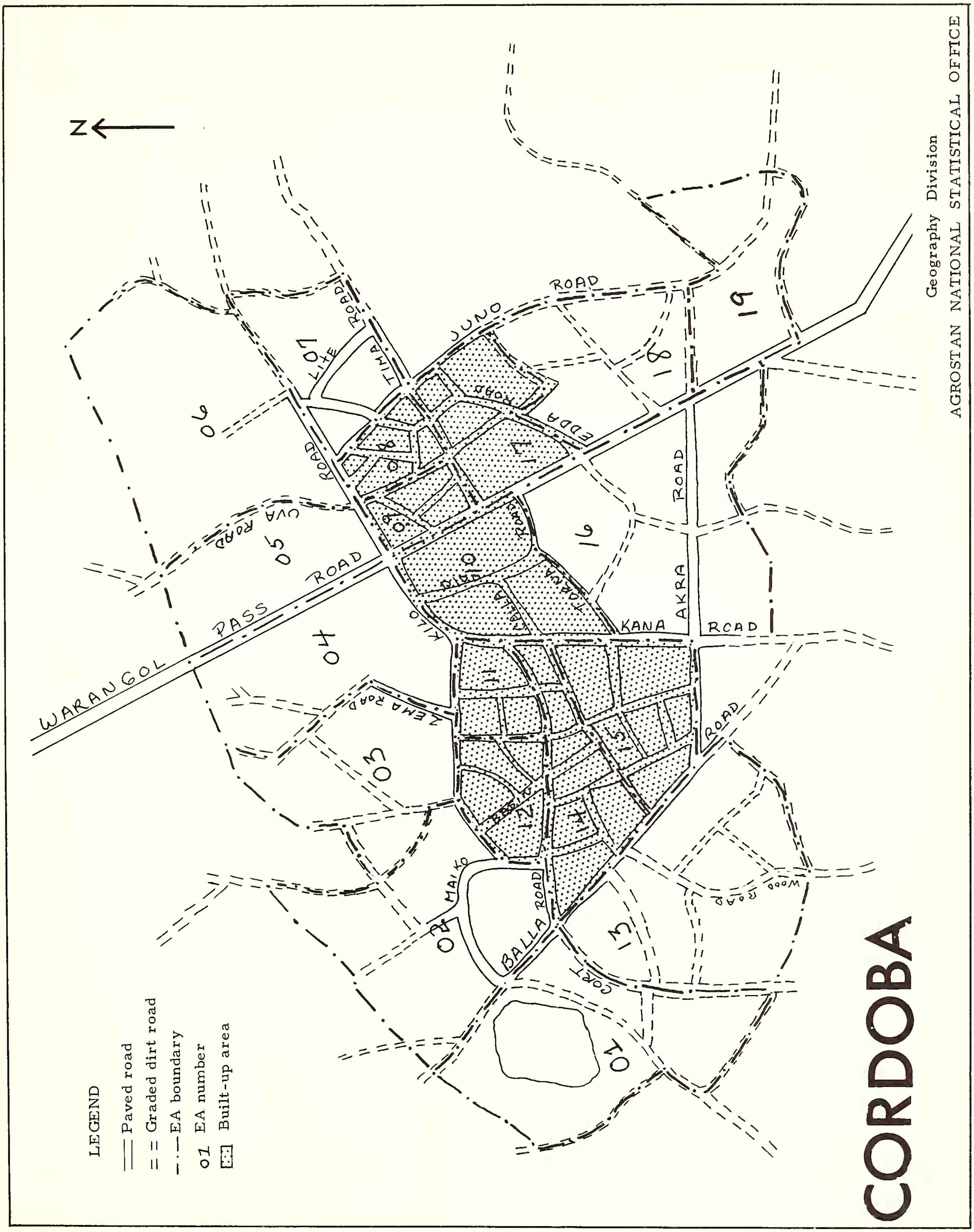


Exhibit IV-3-6. MAP OF RANCHI DISTRICT IN RAJPUR PROVINCE SHOWING ENUMERATION AREAS FOR THE 1970 CENSUS OF POPULATION

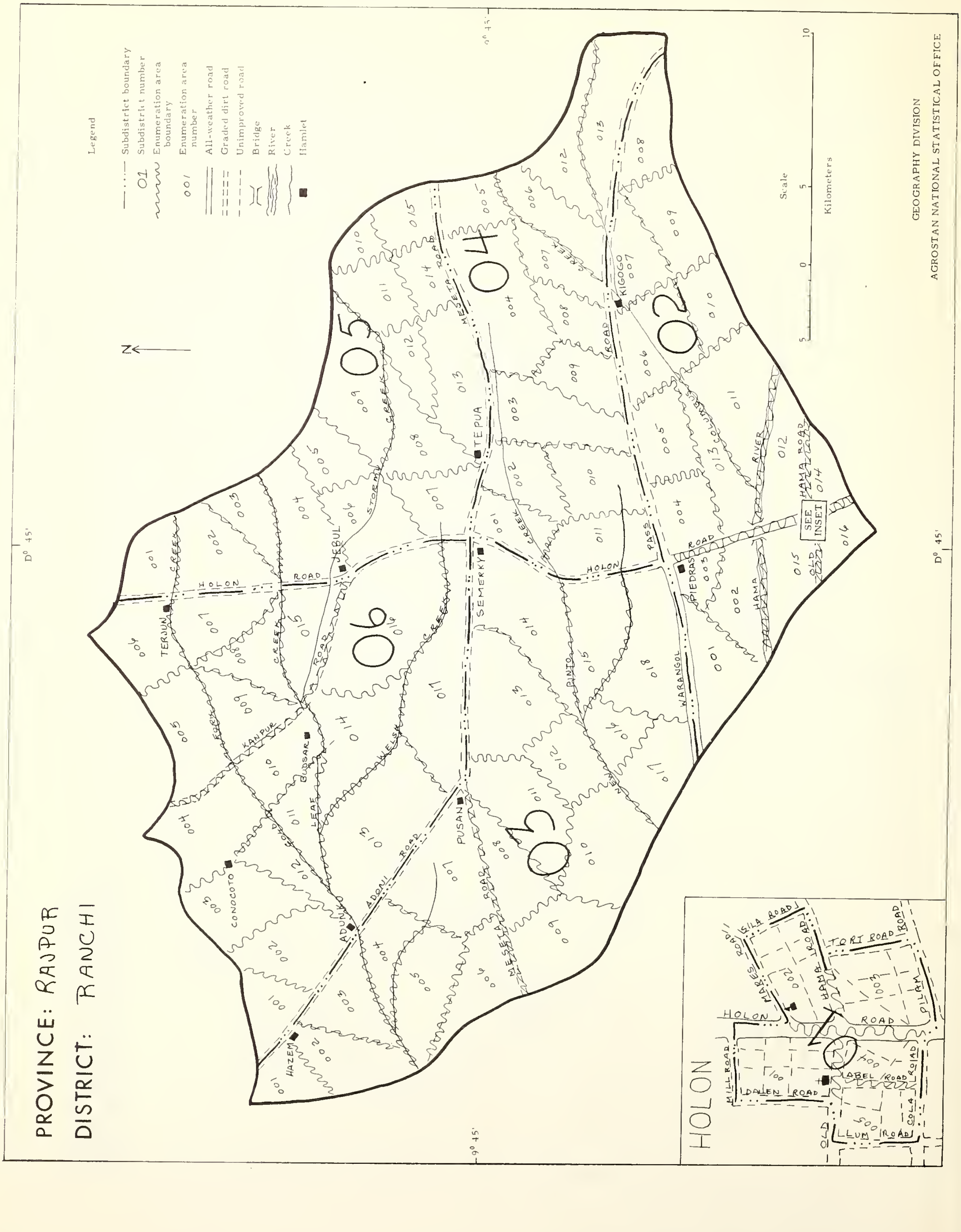
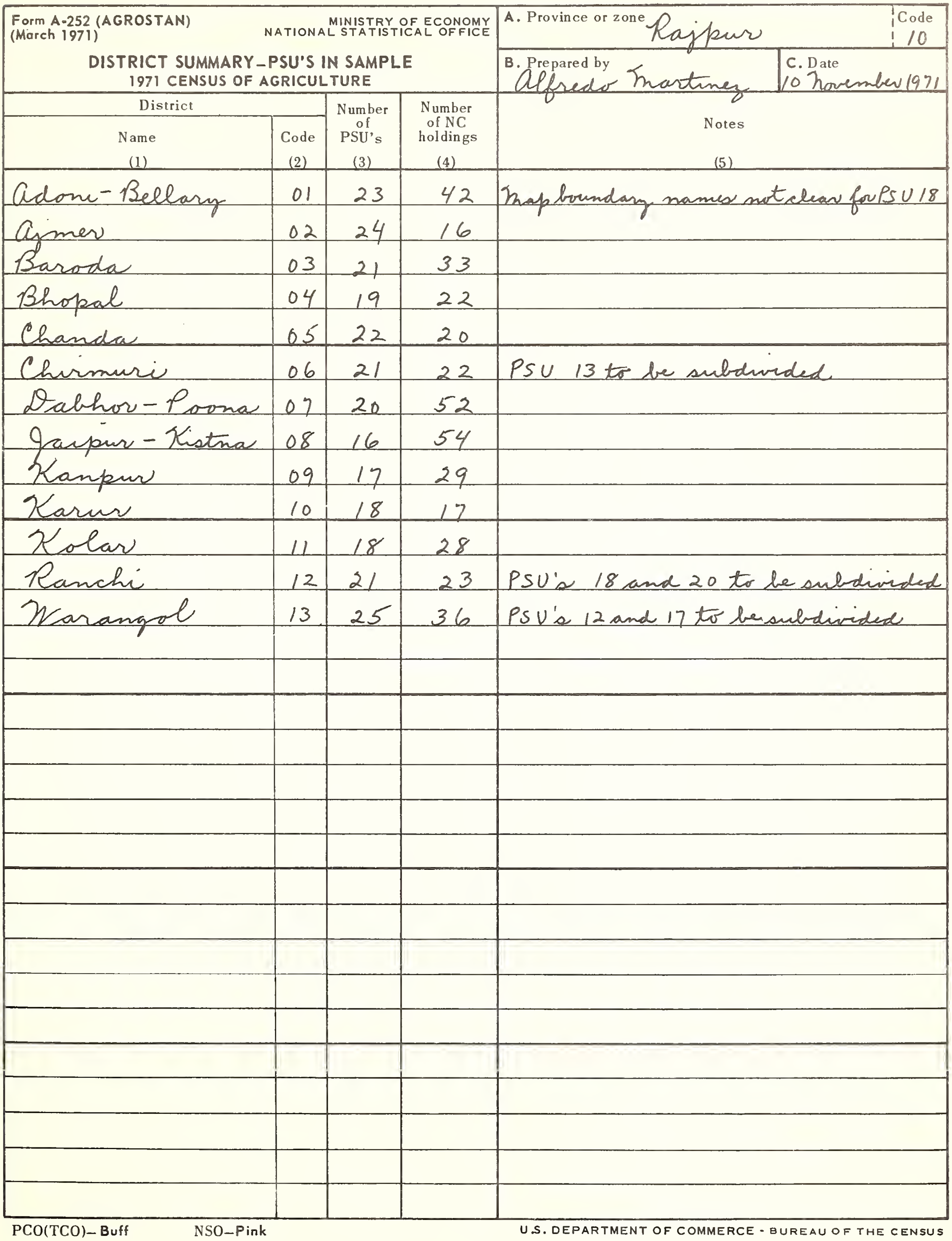


Exhibit IV-3-7. DISTRICT SUMMARY--PSU'S IN SAMPLE, FORM A-252, FOR RAJPUR PROVINCE



Form A-252 (AGROSTAN)
(March 1971)

MINISTRY OF ECONOMY
NATIONAL STATISTICAL OFFICE

DISTRICT SUMMARY–PSU'S IN SAMPLE
1971 CENSUS OF AGRICULTURE

A. Province or zone Rajpur — Code 10

B. Prepared by Alfredo Martinez

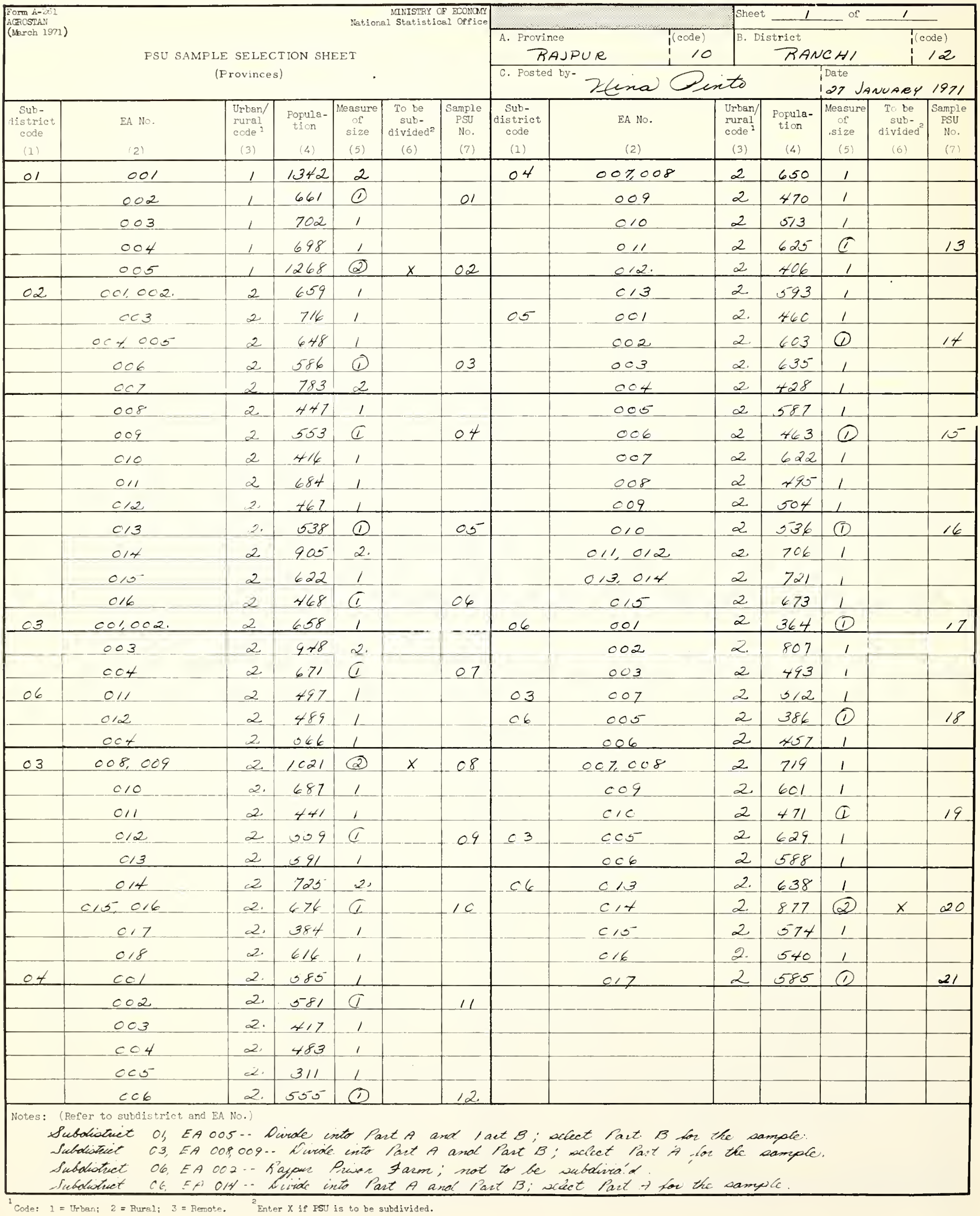
C. Date 10 November 1971

District Name (1)	District Code (2)	Number of PSU's (3)	Number of NC holdings (4)	Notes (5)
Adoni-Bellary	01	23	42	Map boundary names not clear for PSU 18
Ajmer	02	24	16	
Baroda	03	21	33	
Bhopal	04	19	22	
Chanda	05	22	20	
Chirmuri	06	21	22	PSU 13 to be subdivided
Dabhor-Poona	07	20	52	
Jaipur-Kistna	08	16	54	
Kanpur	09	17	29	
Karur	10	18	17	
Kolar	11	18	28	
Ranchi	12	21	23	PSU's 18 and 20 to be subdivided
Warangol	13	25	36	PSU's 12 and 17 to be subdivided

PCO(TCO)—Buff NSO—Pink

U.S. DEPARTMENT OF COMMERCE - BUREAU OF THE CENSUS

Exhibit IV-3-8. PSU SAMPLE SELECTION SHEET (PROVINCES), FORM A-261 FOR RANCHI DISTRICT IN RAJPUR PROVINCE



Form A-261
AGROSTAN
(March 1971)

MINISTRY OF ECONOMY
National Statistical Office

PSU SAMPLE SELECTION SHEET
(Provinces)

Sheet 1 of 1

A. Province RAJPUR (code) 10
B. District RANCHI (code) 12
C. Posted by- Nina Pinto
Date 27 JANUARY 1971

Sub-district code (1)	EA No. (2)	Urban/ rural code[1] (3)	Population (4)	Measure of size (5)	To be sub-divided[2] (6)	Sample PSU No. (7)	Sub-district code (1)	EA No. (2)	Urban/ rural code[1] (3)	Population (4)	Measure of size (5)	To be sub-divided[2] (6)	Sample PSU No. (7)
01	001	1	1342	2			04	007, 008	2	650	1		
	002	1	661	①		01		009	2	470	1		
	003	1	702	1				010	2	513	1		
	004	1	698	1				011	2	625	①		13
	005	1	1268	②	X	02		012.	2	406	1		
02	001, 002.	2	659	1				013	2	593	1		
	003	2	716	1			05	001	2.	460	1		
	004, 005	2	648	1				002	2.	603	①		14
	006	2	586	①		03		003	2.	635	1		
	007	2	783	2				004	2	428	1		
	008	2	447	1				005	2	587	1		
	009	2	553	①		04		006	2	463	①		15
	010	2	416	1				007	2	622	1		
	011	2	684	1				008	2	495	1		
	012	2.	467	1				009	2	504	1		
	013	2.	538	①		05		010	2	536	①		16
	014	2	905	2.				011, 012	2	706	1		
	015	2	622	1				013, 014	2	721	1		
	016	2	468	①		06		015	2	673	1		
03	001, 002.	2	658	1			06	001	2	364	①		17
	003	2	948	2.				002	2.	807	1		
	004	2	671	①		07		003	2	493	1		
06	011	2	497	1			03	007	2	512	1		
	012	2	489	1			06	005	2	386	①		18
	004	2	066	1				006	2	457	1		
03	008, 009	2.	1021	②	X	08		007, 008	2	719	1		
	010	2.	687	1				009	2.	601	1		
	011	2.	441	1				010	2	471	①		19
	012	2	559	①		09	03	005	2	629	1		
	013	2	591	1				006	2	588	1		
	014	2	725	2.			06	013	2.	638	1		
	015, 016	2.	476	①		10		014	2.	877	②	X	20
	017	2.	384	1				015	2	574	1		
	018	2.	616	1				016	2.	540	1		
04	001	2.	585	1				017	2	585	①		21
	002	2.	581	①		11							
	003	2.	417	1									
	004	2.	483	1									
	005	2.	311	1									
	006	2.	555	①		12.							

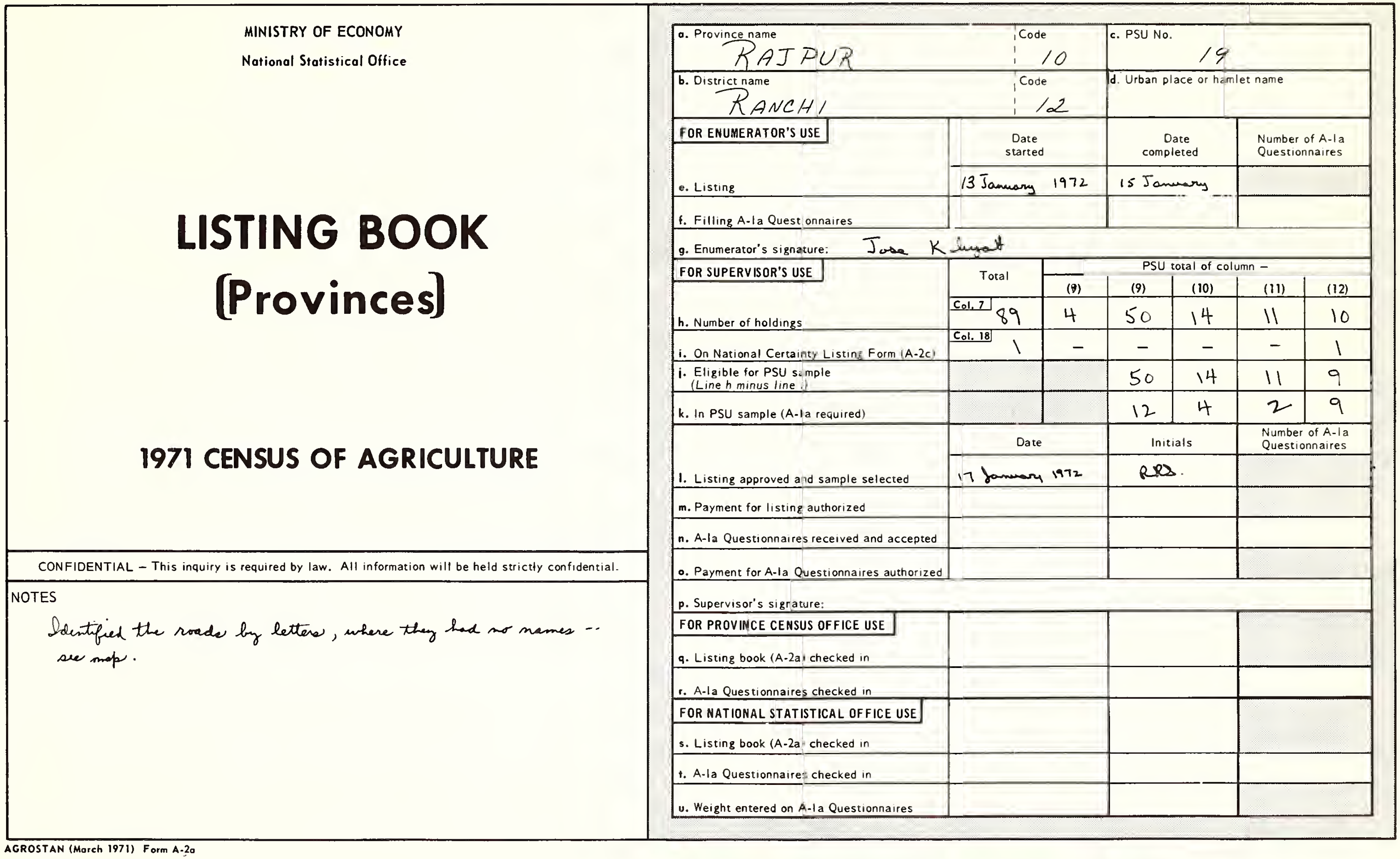
Notes: (Refer to subdistrict and EA No.)

Subdistrict 01, EA 005 -- Divide into Part A and Part B; select Part B for the sample.
Subdistrict 03, EA 008, 009 -- Divide into Part A and Part B; select Part A for the sample.
Subdistrict 06, EA 002 -- Rajpur Prison Farm; not to be subdivided.
Subdistrict 06, EA 014 -- Divide into Part A and Part B; select Part A for the sample.

[1] Code: 1 = Urban; 2 = Rural; 3 = Remote.

[2] Enter X if PSU is to be subdivided.

Exhibit IV-4-1. LISTING BOOK (PROVINCES), FORM A-2a, FOR PSU 19 IN RANCHI DISTRICT, RAJPUR PROVINCE



MINISTRY OF ECONOMY
National Statistical Office

LISTING BOOK (Provinces)

1971 CENSUS OF AGRICULTURE

CONFIDENTIAL – This inquiry is required by law. All information will be held strictly confidential.

NOTES

Identified the roads by letters, where they had no names -- see map.

AGROSTAN (March 1971) Form A-2a

a. Province name RAJPUR	Code 10	c. PSU No. 19
b. District name RANCHI	Code 12	d. Urban place or hamlet name

FOR ENUMERATOR'S USE	Date started	Date completed	Number of A-Ia Questionnaires
e. Listing	13 January 1972	15 January	
f. Filling A-Ia Questionnaires			

g. Enumerator's signature: Jose K

FOR SUPERVISOR'S USE	Total	PSU total of column –				
		(8)	(9)	(10)	(11)	(12)
h. Number of holdings	Col. 7 89	4	50	14	11	10
i. On National Certainty Listing Form (A-2c)	Col. 18 1	–	–	–	–	1
j. Eligible for PSU sample (Line h minus line i)			50	14	11	9
k. In PSU sample (A-Ia required)			12	4	2	9

	Date	Initials	Number of A-Ia Questionnaires
l. Listing approved and sample selected	17 January 1972	RRS.	
m. Payment for listing authorized			
n. A-Ia Questionnaires received and accepted			
o. Payment for A-Ia Questionnaires authorized			

p. Supervisor's signature:

FOR PROVINCE CENSUS OFFICE USE			
q. Listing book (A-2a) checked in			
r. A-Ia Questionnaires checked in			

FOR NATIONAL STATISTICAL OFFICE USE			
s. Listing book (A-2a) checked in			
t. A-Ia Questionnaires checked in			
u. Weight entered on A-Ia Questionnaires			

Exhibit IV-4-1. LISTING BOOK (PROVINCES), FORM A-2a, FOR PSU 19 IN RANCHI DISTRICT, RAJPUR PROVINCE--Continued

REMINDERS

Canvassing	Locate each housing unit within the PSU boundaries. List in systematic order. Follow each road or path to be sure you find all housing units. Indicate direction of travel on the PSU map.
Listing	List each household on a separate line of the Listing Book, and fill the appropriate columns. If the housing unit is vacant, write VACANT in the space for "Name of head" in column 3; enter "Location of unit" in column 3; and leave columns 4 to 21 blank. When each line is completed, enter "X" in column 22.
Callbacks	Make return visits when you cannot find a reliable respondent. Keep a record of callbacks in column 22.
"None" Entry	If "None" for column 13, 14, or 15, enter a dash (–). Do not leave blank.
Housing Unit	House, hut, tent, room, or group of rooms occupied or intended for occupancy as separate living quarters by a family or other group of persons living together, or by a person living alone.
Household	The person or group of persons who occupy one housing unit. The household may include nonrelatives (such as lodgers, servants, hired hands).
Polygamous Husband	Husband with more than one wife. If the wives live with the husband in the same household, list the husband as head; if the wives live in separate households, list the husband with the first-married wife and consider him as the head. Consider the husband as the holder if he grows any crops or keeps any livestock.
Grow Crops	Refers to the seeding, planting, or caring of crops (now or at any time during 1971) with the intention of harvesting or selling them.
Keep Livestock	Refers to all livestock and poultry on the holding (now or at any time during 1971) regardless of ownership. Includes livestock owned by the holder if they are on common or public grazing land. Also includes bees, silkworms, rabbits and other fur-bearing animals in captivity on the holding.
Holding	Land which is used wholly or partly for agricultural production and is operated as a unit; that is, under the same management and with the same means of production (labor force, machinery, or animals). A holding may comprise more than one parcel of land.
Holder or Person in Charge	The person who makes the day-to-day decisions concerning the operations of a holding. The holder may do the work himself or he may supervise the work of others.
On Own Account	Holding operated by an individual or members of a household independently from any other holding or persons. The holder is not responsible to any other person(s) for the operations of the holding. The holder need not own the land.
In Partnership	Holding operated by two or more persons who share in the operations and the agricultural production of the holding. Partners may live in the same household or in separate households.
As Hired Manager	Holding operated by a person who takes the responsibility for the operations of the holding. He makes the day-to-day decisions and either does the work himself or supervises the work of others, employing additional labor if necessary. He is generally paid a salary or may receive a share of the agricultural production. Do not confuse him with a hired man or caretaker who simply carries out his employer's instructions.
As Chieftain (Headman)	Holding operated by the administrative head or leader of a tribe or clan. The chieftain supervises tribal land which is not assigned to members.

LAND AREA CONVERSION FACTORS

1 tanbo = 1/10 (0.1) of a hectare. To convert tanbos to hectares, multiply the number of tanbos by 1/10 (or 0.1). If less than 1 hectare, report in tenths; if more than 1 hectare, round to the nearest whole number. Check your results as follows:

If number of tanbos is –	Then converted figure (hectares) should be in –
Less than 1	Column 8 (*Mark "X"*)
1 – 499	Column 9
500 – 999	Column 10
1000 – 1999	Column 11
2000 or more	Column 12

1 manzana = 6/10 (0.6) of a hectare. To convert manzanas to hectares, multiply the number of manzanas by 6/10 (or 0.6). If less than 1 hectare, report in tenths; if more than 1 hectare, round to the nearest whole number. Check your results as follows:

If number of manzanas is –	Then converted figure (hectares) should be in –
Less than 0.17	Column 8 (*Mark "X"*)
0.17 – 83	Column 9
84 – 166	Column 10
167 – 333	Column 11
334 or more	Column 12

CROP FOR COLUMN 14

Ask about –

WHEAT	in Bolivar, Lo-San-Tho, Paris, and Rajpur Provinces.
RICE	in all other provinces.

If response is not given in hectares, be sure to convert to hectares before making the entry in column 14.

WHEN TO FILL A-1a QUESTIONNAIRE

Fill an A-1a for each holding represented by a circled number in column 9, 10, 11 or 12 of the A-2a Listing Book. In some cases, you may have more than one entry in these columns for the same holder: for example, a holding operated "on own account" and a second holding operated "as hired manager or chieftain." If both are circled, fill an A-1a for each holding; if only one is circled, fill an A-1a for that holding; if neither is circled, do not fill A-1a.

Exhibit IV-4-1. LISTING BOOK (PROVINCES), FORM A-2a, FOR PSU 19 IN RANCHI DISTRICT, RAJPUR PROVINCE--Continued

Page 1

Line No.	Road name or No.	Name of head of household and location or description of housing unit	Does any member of this household –		What is the name of each member of this household who operates (has charge of) an agricultural holding? (Use a separate line for each such member, beginning with column 6, for partners in same household, however, use only one line.)	How does this person operate the holding – on own account, in partnership, as hired manager or chieftain? (Mark as many as applicable)	How much land does this person have—including cropland, pastureland, woodland, etc.? Do NOT include land rented out or land operated by others. For partnership, report total amount of land – not just your share. (Enter X in column 8 or amount in column 9, 10, 11, or 12.)					What is the name of this holding?	On how much land did you grow . . . at any time during 1971? (See inside front cover) (hectares)	How many cattle and calves of all ages are now on this holding – including those on common or public land if owned [by you] [by your employer] [jointly by your tribe or clan]?	Respondent	FOR SUPERVISOR'S USE				FOR ENUMERATOR'S USE	FOR SUPERVISOR'S USE	NOTES (Explanations, callback information, instructions, etc.)
			Grow any crops of any kind–field, garden, or tree crops, etc. (now or at any time during 1971)? (If NO in both columns 4 and 5, skip to 16)	Keep any livestock or poultry (now or at any time during 1971)?			Under 1/10 hectare	1/10 to 49 hectares	50 to 99 hectares	100 to 199 hectares	200 or more hectares					Date listing approved	National Certainty holding YES	NO	Preliminary A-1a No.	Date A-1a completed	Date A-1a approved	
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)		(19)	(20)	(21)	(22)
1	Kanpur Road	Name of head Silva Bella Location of unit northwest corner Kanpur and Adunko Roads.	☒ Yes ☐ No	☐ Yes ☒ No	Silva Bella	☒ On own account ☐ In partnership ☐ As hired manager or chieftain		4/10				—	—	—	☒ Head ☐ Wife ☐ Other relative ☐ Other (Specify)	14 Jan ↓		X				X
2		Name of head Abu Ben Bella Location of unit next to Leaf Creek	☐ Yes ☒ No	☐ Yes ☒ No		☐ On own account ☐ In partnership ☐ As hired manager or chieftain									☒ Head ☐ Wife ☐ Other relative ☐ Other (Specify)							X
3	Adunko Road	Name of head Zabara Abel Location of unit first house on left from Kanpur Road	☒ Yes ☐ No	☒ Yes ☐ No	Zabara Abel	☒ On own account ☐ In partnership ☐ As hired manager or chieftain		21				—	18 3/10	2	☒ Head ☐ Wife ☐ Other relative ☐ Other (Specify)			X				X
4		Name of head Muhamed Heussaf Location of unit stone house, stone fence in front. On right side	☒ Yes ☐ No	☒ Yes ☐ No	Muhamed Heussaf	☐ On own account ☒ In partnership ☐ As hired manager or chieftain		32				—	20 6/10	—	☒ Head ☐ Wife ☐ Other relative ☐ Other (Specify)			X				X Partnership with cousin Sudani's, line 10.
5		Name of head Lusambo Monkato Location of unit green stucco on right side.	☒ Yes ☐ No	☐ Yes ☒ No	Lusambo Monkato	☒ On own account ☐ In partnership ☐ As hired manager or chieftain	X					—	—	—	☒ Head ☐ Wife ☐ Other relative ☐ Other (Specify)			X				X
6		Name of head Fatima Tarim Location of unit small brick white roof. On left side.	☒ Yes ☐ No	☒ Yes ☐ No	Fatima Tarim Anton Tarim	☐ On own account ☒ In partnership ☐ As hired manager or chieftain				127		La A taifor Farm	100	5	☒ Head ☐ Wife ☐ Other relative ☐ Other (Specify)			X				X
7		Name of head Juan Montero Location of unit 2-story stone, shed in back. On left side.	☒ Yes ☐ No	☐ Yes ☒ No	Ramon Montero	☒ On own account ☐ In partnership ☐ As hired manager or chieftain		⑰				—	16	—	☒ Head ☐ Wife ☐ Other relative ☐ Other (Specify)			X	\			X
8		Name of head Komba Sudani Location of unit white stucco, green roof. On right side	☒ Yes ☐ No	☐ Yes ☒ No	Komba Sudani	☒ On own account ☐ In partnership ☐ As hired manager or chieftain		1				—	—	—	☒ Head ☐ Wife ☐ Other relative ☐ Other (Specify)			X				X
9		Name of head Yuda Golosi Location of unit brown mud brick. On right side	☒ Yes ☐ No	☒ Yes ☐ No	Yuda Golosi	☒ On own account ☐ In partnership ☒ As hired manager or chieftain		2 3/10	78			—	— 60	1 —	☒ Head ☐ Wife ☐ Other relative ☐ Other (Specify)			X X				X X
10		Name of head Rega Mohanni Location of unit small frame, unpainted. On right side	☒ Yes ☐ No	☒ Yes ☐ No	Rega Mohanni	☒ On own account ☐ In partnership ☐ As hired manager or chieftain		5/10				—	—	1	☐ Head ☒ Wife ☐ Other relative ☐ Other (Specify)	14 Jan		X				X
		TOTAL ENTRIES (Including wavy-line entries) →				10	1	7	1	1	—	→					—	10				

Exhibit IV-4-1. LISTING BOOK (PROVINCES), FORM A-2a, FOR PSU 19 IN RANCHI DISTRICT, RAJPUR PROVINCE--Continued

Page 2

Line No.	Road name or No.	Name of head of household and location or description of housing unit	Does any member of this household –		What is the name of each member of this household who operates (has charge of) an agricultural holding?	How does this person operate the holding – on own account, in partnership, as hired manager or chieftain?	How much land does this person have—including cropland, pastureland, woodland, etc.? Do NOT include land rented out or land operated by others. For partnership, report total amount of land – not just your share. (Enter X in column 8 or amount in column 9, 10, 11, or 12.)					What is the name of this holding?	On how much land did you grow . . . at any time during 1971? (See inside front cover) (hectares)	How many cattle and calves of all ages are now on this holding – including those on common or public land if owned [by you] [by your employer] [jointly by your tribe or clan]?	Respondent	FOR SUPERVISOR'S USE				FOR ENUMERATOR'S USE	FOR SUPERVISOR'S USE	NOTES (Explanations, callback information, instructions, etc.)
			Grow any crops of any kind–field, garden, or tree crops, etc. (now or at any time during 1971)?	Keep any livestock or poultry (now or at any time during 1971)?	(Use a separate line for each such member, beginning with column 6; for partners in same household, however, use only one line.)	(Mark as many as applicable)	Under 1/10 hectare	1/10 to 49 hectares	50 to 99 hectares	100 to 199 hectares	200 or more hectares					Date listing approved	National Certainty holding		Preliminary A-1a No.	Date A-1a completed	Date A-1a approved	
			(If NO in both columns 4 and 5, skip to 16)														YES	NO				
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)		(19)	(20)	(21)	(22)
1	Adunko Road	Name of head Paul Krumro Location of unit white stucco black roof. On right	☒ Yes ☐ No	☒ Yes ☐ No	Paul Kraumo	☒ On own account ☐ In partnership ☐ As hired manager or chieftain		(22)				—	10 2/10	—	☐ Head ☒ Wife ☐ Other relative ☐ Other (Specify)	14 Jan		X	2			X
2		Name of head Miridula Advenwala Location of unit large brick, white fence in front	☒ Yes ☐ No	☒ Yes ☐ No	Miridula Advenwala	☒ On own account ☐ In partnership ☐ As hired manager or chieftain		5				—	3 1/10	—	☒ Head ☐ Wife ☐ Other relative ☐ Other (Specify)	14 Jan		X				X
3		Name of head Tanya Walla Location of unit small green stucco, green roof. On right side	☒ Yes ☐ No	☐ Yes ☒ No	Tanya Walla	☒ On own account ☐ In partnership ☐ As hired manager or chieftain		10				—	9 –/10	—	☒ Head ☐ Wife ☐ Other relative ☐ Other (Specify)	14 Jan		X				X
4		Name of head David Hazam Location of unit red brick, wood porch in front. On right side	☐ Yes ☒ No	☐ Yes ☒ No		☐ On own account ☐ In partnership ☐ As hired manager or chieftain									☒ Head ☐ Wife ☐ Other relative ☐ Other (Specify)	14 Jan						X
5		Name of head Riccardo Cauldio Location of unit gray cinder-block, steel roof. On right side	☐ Yes ☒ No	☒ Yes ☐ No	Riccardo Cauldio Ramon Torres	☐ On own account ☒ In partnership ☐ As hired manager or chieftain				112		—	—	23	☐ Head ☐ Wife ☐ Other relative ☒ Other (Specify) Neighbor	14 Jan.		X				X
6		Name of head Daniel Sitta Location of unit gray stone, white door. No windows in front. On right side	☒ Yes ☐ No	☒ Yes ☐ No	Daniel Sitta	☒ On own account ☐ In partnership ☐ As hired manager or chieftain		2				—	1 1/10	—	☒ Head ☐ Wife ☐ Other relative ☐ Other (Specify)	14 Jan.		X				X
7		Name of head Eduardo Landrone Location of unit red brick, small shed at side of house. On right side.	☒ Yes ☐ No	☐ Yes ☒ No	Eduardo Landrone	☒ On own account ☒ In partnership ☐ As hired manager or chieftain		(3)	(75)			— —	1 1/10 60 2/10	– –	☒ Head ☐ Wife ☐ Other relative ☐ Other (Specify)			X X	3 4			X Could this be X all one holding? Please verify.
8	Road B	Name of head Antonio Bolos Location of unit across street from store	☒ Yes ☐ No	☒ Yes ☐ No	Antonio Bolos	☒ On own account ☐ In partnership ☐ As hired manager or chieftain		3 3/10				—	3 –/10	–	☒ Head ☐ Wife ☐ Other relative ☐ Other (Specify)	14 Jan.		X				X
9		Name of head Mui-jih Lin Location of unit white stucco green roof.	☒ Yes ☐ No	☐ Yes ☒ No	Mui-jih Lin	☒ On own account ☐ In partnership ☐ As hired manager or chieftain		4 5/10				—	2 –/10	–	☐ Head ☒ Wife ☐ Other relative ☐ Other (Specify)			X				X
10		Name of head Location of unit	☐ Yes ☐ No	☐ Yes ☐ No	Choo Lin	☐ On own account ☒ In partnership ☐ As hired manager or chieftain		43				—	38 5/10	–	☐ Head ☒ Wife ☐ Other relative ☐ Other (Specify)			X				X Partnership with cousin. See sheet 1, line 4
TOTAL ENTRIES (Including wavy-line entries) →						10	–	8	1	1	–	→					–	10				

Exhibit IV-4-1. LISTING BOOK (PROVINCES), FORM A-2a, FOR PSU 19 IN RANCHI DISTRICT, RAJPUR PROVINCE--Continued

Page 3

Line No.	Road name or No.	Name of head of household and location or description of housing unit	Does any member of this household — Grow any crops of any kind—field, garden, or tree crops, etc. (now or at any time during 1971)? (If NO in both columns 4 and 5, skip to 16)	Keep any livestock or poultry (now or at any time during 1971)?	What is the name of each member of this household who operates (has charge of) an agricultural holding? (Use a separate line for each such member, beginning with column 6; for partners in same household, however, use only one line.)	How does this person operate the holding — on own account, in partnership, as hired manager or chieftain? (Mark as many as applicable)	How much land does this person have—including cropland, pastureland, woodland, etc.? Do NOT include land rented out or land operated by others. For partnership, report total amount of land – not just your share. (Enter X in column 8 or amount in column 9, 10, 11, or 12.) Under 1/10 hectare	1/10 to 49 hectares	50 to 99 hectares	100 to 199 hectares	200 or more hectares	What is the name of this holding?	On how much land did you grow . . . at any time during 1971? (See inside front cover) (hectares)	How many cattle and calves of all ages are now on this holding – including those on common or public land if owned [by you] [by your employer] [jointly by your tribe or clan]?	Respondent	FOR SUPERVISOR'S USE: Date listing approved	National Certainty holding YES	NO	Preliminary A-1a No.	FOR ENUMERATOR'S USE: Date A-1a completed	FOR SUPERVISOR'S USE: Date A-1a approved	NOTES (Explanations, callback information, instructions, etc.)
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)		(19)	(20)	(21)	(22)
1	Road B	Name of head Munir Patra Location of unit across street from school	☐ Yes ☒ No	☐ Yes ☒ No		☐ On own account ☐ In partnership ☐ As hired manager or chieftain							/10 /10 /10		☐ Head ☒ Wife ☐ Other relative ☐ Other (Specify)							X
2	Road C	Name of head Vacant Location of unit at end of road.	☐ Yes ☐ No	☐ Yes ☐ No		☐ On own account ☐ In partnership ☐ As hired manager or chieftain							/10 /10 /10		☐ Head ☐ Wife ☐ Other relative ☒ Other (Specify) Neighbor							X
3		Name of head Abdul Lumba Location of unit corner of roads A and C	☒ Yes ☐ No	☐ Yes ☒ No	Abdul Lumba	☒ On own account ☐ In partnership ☐ As hired manager or chieftain	X					—	— /10 /10 /10	—	☒ Head ☐ Wife ☐ Other relative ☐ Other (Specify)			X				X
4	Road D	Name of head Marc Dumas Location of unit corner of roads A and D	☐ Yes ☒ No	☐ Yes ☒ No		☐ On own account ☐ In partnership ☐ As hired manager or chieftain							/10 /10 /10		☒ Head ☐ Wife ☐ Other relative ☐ Other (Specify)							X
5		Name of head Simon Mallo Location of unit first house from corner on right side	☐ Yes ☒ No	☐ Yes ☒ No		☐ On own account ☐ In partnership ☐ As hired manager or chieftain							/10 /10 /10		☒ Head ☐ Wife ☐ Other relative ☐ Other (Specify)							X
6		Name of head Jose Cristo Location of unit house at end of road	☒ Yes ☐ No	☒ Yes ☐ No	Jose Cristo	☒ On own account ☐ In partnership ☐ As hired manager or chieftain					257	La Azanca	43 -/10 /10 /10	—	☒ Head ☐ Wife ☐ Other relative ☐ Other (Specify)			X	5			X
7		Name of head Martin Cato Location of unit corner of roads D and E	☒ Yes ☐ No	☐ Yes ☒ No	Martin Cato	☒ On own account ☐ In partnership ☐ As hired manager or chieftain		25 1/10					20 -/10 /10 /10	—	☒ Head ☐ Wife ☐ Other relative ☐ Other (Specify)			X	6			X
8	Road E	Name of head Amed Hussain Location of unit grey stone, black roof. On right side	☐ Yes ☒ No	☒ Yes ☐ No	Amed Hussain	☒ On own account ☐ In partnership ☐ As hired manager or chieftain	X					—	— /10 /10 /10	—	☒ Head ☐ Wife ☐ Other relative ☐ Other (Specify)			X				X
9		Name of head Solomon Chu Location of unit end of road on right side	☐ Yes ☒ No	☒ Yes ☐ No	Solomon Chu	☒ On own account ☐ In partnership ☐ As hired manager or chieftain	X					—	— /10 /10 /10	—	☐ Head ☐ Wife ☐ Other relative ☒ Other (Specify) Neighbor			X				X
10		Name of head Fred Pung Location of unit end of road on right side.	☒ Yes ☐ No	☒ Yes ☐ No	Fred Pung	☒ On own account ☐ In partnership ☐ As hired manager or chieftain			74			—	65 -/10 /10 /10	—	☒ Head ☐ Wife ☐ Other relative ☐ Other (Specify)			X				X
TOTAL ENTRIES (Including wavy-line entries) →						6	3	1	1	-	1	→					-	6				

Exhibit IV-4-1. LISTING BOOK (PROVINCES), FORM A-2a, FOR PSU 19 IN RANCHI DISTRICT, RAJPUR PROVINCE--Continued

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Line No.	Road name or No.	Name of head of household and location or description of housing unit	Does any member of this household —		What is the name of each member of this household who operates (has charge of) an agricultural holding? (Use a separate line for each such member, beginning with column 6; for partners in some household, however, use only one line.)	How does this person operate the holding — on own account, in partnership, as hired manager or chieftain? (Mark as many as applicable)	How much land does this person have—including cropland, pastureland, woodland, etc.? Do NOT include land rented out or land operated by others. For partnership, report total amount of land — not just your share. (Enter X in column 8 or amount in column 9, 10, 11, or 12.)					What is the name of this holding?	On how much land did you grow . . . at any time during 1971? (See inside front cover) (hectares)	How many cattle and calves of all ages are now on this holding — including those on common or public land if owned [by you] [by your employer] [jointly by your tribe or clan]?	Respondent	FOR SUPERVISOR'S USE				FOR ENUMERATOR'S USE	FOR SUPERVISOR'S USE	NOTES (Explanations, callback information, instructions, etc.)
			Grow any crops of any kind—field, garden, or tree crops, etc. (now or at any time during 1971)?	Keep any livestock or poultry (now or at any time during 1971)?			Under 1/10 hectare	1/10 to 49 hectares	50 to 99 hectares	100 to 199 hectares	200 or more hectares					Date listing approved	National Certainty holding (18) YES	NO	Preliminary A-1a No.	Date A-1a completed	Date A-1a approved	
(1)	(2)	(3)	(If NO in both columns 4 and 5, skip to 16) (4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	YES	NO	(19)	(20)	(21)	(22)
1	Road F	Name of head Ferdinando Palto Location of unit gray stucco, green fence in front	☒ Yes ☐ No	☐ Yes ☒ No	Ferdinando Palto	☒ On own account ☐ In partnership ☐ As hired manager or chieftain		3				—	— /10 /10 /10	—	☒ Head ☐ Wife ☐ Other relative ☐ Other (Specify)			X				X
2		Name of head Location of unit	☐ Yes ☐ No	☐ Yes ☐ No	Chris Palto	☒ On own account ☐ In partnership ☐ As hired manager or chieftain		5				—	4 5/10 /10 /10	—	☒ Head ☐ Wife ☐ Other relative ☐ Other (Specify)			X				X
3		Name of head Conrad Mann Location of unit corner of roads A and F	☐ Yes ☒ No	☒ Yes ☐ No	Conrad Mann	☒ On own account ☐ In partnership ☐ As hired manager or chieftain					(215)	Cedars	— /10 /10 /10	75	☐ Head ☒ Wife ☐ Other relative ☐ Other (Specify)			X	7			X
4	Road A	Name of head Vacant Location of unit small store, no windows or door-burned out	☐ Yes ☐ No	☐ Yes ☐ No		☐ On own account ☐ In partnership ☐ As hired manager or chieftain							/10 /10 /10		☐ Head ☐ Wife ☐ Other relative ☐ Other (Specify)							X
5	Road G	Name of head John Kakto Location of unit corner roads A and G. Red brick	☐ Yes ☒ No	☒ Yes ☐ No	John Kakto	☒ On own account ☐ In partnership ☐ As hired manager or chieftain		1				—	— /10 /10 /10	—	☒ Head ☐ Wife ☐ Other relative ☐ Other (Specify)			X				X
6		Name of head Benjamin Lampros Location of unit brown stucco, white roof. On right side	☒ Yes ☐ No	☒ Yes ☐ No	Ben Lampros	☐ On own account ☒ In partnership ☐ As hired manager or chieftain					(432)	La Mesa	/10 400 – /10 /10	78	☒ Head ☐ Wife ☐ Other relative ☐ Other (Specify)			X	8			X
7		Name of head Norman Hulse Location of unit small stone house, red fence in front. On left side.	☒ Yes ☐ No	☒ Yes ☐ No	Norman Hulse	☒ On own account ☐ In partnership ☐ As hired manager or chieftain				125		—	110 – /10 /10 /10	15	☐ Head ☒ Wife ☐ Other relative ☐ Other (Specify)			X				X
8		Name of head Vacant Location of unit unpainted frame part of roof fallen in	☐ Yes ☐ No	☐ Yes ☐ No		☐ On own account ☐ In partnership ☐ As hired manager or chieftain							/10 /10 /10		☐ Head ☐ Wife ☐ Other relative ☐ Other (Specify)							X House has been abandoned
9		Name of head Mark Tiftijian Location of unit at end of Road G	☒ Yes ☐ No	☒ Yes ☐ No	Mark Tiftijian	☒ On own account ☒ In partnership ☐ As hired manager or chieftain		(2)	73			— —	— /10 60 – /10 /10	— 23	☒ Head ☐ Wife ☐ Other relative ☐ Other (Specify)			X X	9			X X
10	Road H	Name of head Peter Kakta Location of unit corner roads G and H.	☐ Yes ☒ No	☒ Yes ☐ No	Peter Kakta	☒ On own account ☐ In partnership ☐ As hired manager or chieftain		5				—	/10 /10 /10	1	☒ Head ☐ Wife ☐ Other relative ☐ Other (Specify)			X				X
TOTAL ENTRIES (Including wavy-line entries) →						9	–	5	1	1	2	→					–	9				

Exhibit IV-4-1. LISTING BOOK (PROVINCES), FORM A-2a, FOR PSU 19 IN RANCHI DISTRICT, RAJPUR PROVINCE--Continued

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Line No. (1)	Road name or No. (2)	Name of head of household and location or description of housing unit (3)	Does any member of this household — Grow any crops of any kind—field, garden, or tree crops, etc. (now or at any time during 1971)? (If NO in both columns 4 and 5, skip to 16) (4)	Keep any livestock or poultry (now or at any time during 1971)? (5)	What is the name of each member of this household who operates (has charge of) an agricultural holding? (Use a separate line for each such member, beginning with column 6, for partners in same household, however, use only one line.) (6)	How does this person operate the holding — on own account, in partnership, as hired manager or chieftain? (Mark as many as applicable) (7)	How much land does this person have—including cropland, pastureland, woodland, etc.? Do NOT include land rented out or land operated by others. For partnership, report total amount of land — not just your share. (Enter X in column 8 or amount in column 9, 10, 11, or 12.) Under 1/10 hectare (8)	1/10 to 49 hectares (9)	50 to 99 hectares (10)	100 to 199 hectares (11)	200 or more hectares (12)	What is the name of this holding? (13)	On how much land did you grow . . . at any time during 1971? (See inside front cover) (hectares) (14)	How many cattle and calves of all ages are now on this holding — including those on common or public land if owned [by you] [by your employer] [jointly by your tribe or clan]? (15)	Respondent (16)	FOR SUPERVISOR'S USE: Date listing approved (17)	National Certainty holding (18) YES	(18) NO	Preliminary A-1a No. (19)	FOR ENUMERATOR'S USE: Date A-1a completed (20)	FOR SUPERVISOR'S USE: Date A-1a approved (21)	NOTES (Explanations, callback information, instructions, etc.) (22)
1	Road I	Name of head Art Bolos Location of unit house at end of road.	☐ Yes ☒ No	☐ Yes ☒ No		☐ On own account ☐ In partnership ☐ As hired manager or chieftain									☒ Head ☐ Wife ☐ Other relative ☐ Other (Specify)							X
2		Name of head Anton Yeracaris Location of unit corner roads I and K (southwest)	☐ Yes ☒ No	☒ Yes ☐ No	Anton Yeracaris	☒ On own account ☐ In partnership ☐ As hired manager or chieftain		41				—	—	3	☒ Head ☐ Wife ☐ Other relative ☐ Other (Specify)			X				X
3		Name of head Andreas Vorta Location of unit house next to church	☒ Yes ☐ No	☒ Yes ☐ No	Andreas Vorta	☒ On own account ☐ In partnership ☐ As hired manager or chieftain					340	Vorta Wheat Farm	300	10	☒ Head ☐ Wife ☐ Other relative ☐ Other (Specify)			X	10			X
4		Name of head Thomas Mann Location of unit corner roads I and K (southeast)	☒ Yes ☐ No	☒ Yes ☐ No	Thomas Mann	☒ On own account ☐ In partnership ☐ As hired manager or chieftain				173		—	17	100	☒ Head ☐ Wife ☐ Other relative ☐ Other (Specify)			X	11			X
5	Road A	Name of head Alfredo Turza Location of unit grey stone green roof. On right side	☒ Yes ☐ No	☐ Yes ☒ No	Alfredo Turja	☒ On own account ☐ In partnership ☐ As hired manager or chieftain		45				—	41	—	☒ Head ☐ Wife ☐ Other relative ☐ Other (Specify)			X				X
6	Road J	Name of head Reed Grager Location of unit white stucco with green roof.	☒ Yes ☐ No	☒ Yes ☐ No	Reed Grager	☒ On own account ☐ In partnership ☐ As hired manager or chieftain			92			—	27	10	☒ Head ☐ Wife ☐ Other relative ☐ Other (Specify)			X				X
7	Road K	Name of head Eric Leinwander Location of unit grey stucco with wire fence in front	☒ Yes ☐ No	☐ Yes ☒ No	Eric Leinwander	☒ On own account ☐ In partnership ☐ As hired manager or chieftain		37				—	30	—	☒ Head ☐ Wife ☐ Other relative ☐ Other (Specify)			X	12			X
8	Road J	Name of head Vahan Khanzadian Location of unit corner of roads J and K.	☐ Yes ☒ No	☒ Yes ☐ No	Vahan Khanzadian	☐ On own account ☒ In partnership ☐ As hired manager or chieftain			76			—	—	—	☐ Head ☒ Wife ☐ Other relative ☐ Other (Specify)			X	13			X
9		Name of head Sydney Morris Location of unit end of road. Green stucco	☒ Yes ☐ No	☒ Yes ☐ No	Sydney Morris	☒ On own account ☐ In partnership ☐ As hired manager or chieftain			71			—	20	—	☐ Head ☒ Wife ☐ Other relative ☐ Other (Specify)			X				X
10		Name of head Laurence Kopp Location of unit end of road, red brick	☐ Yes ☒ No	☐ Yes ☒ No		☐ On own account ☐ In partnership ☐ As hired manager or chieftain									☐ Head ☐ Wife ☒ Other relative ☐ Other (Specify)							X
TOTAL ENTRIES (Including wavy-line entries) →						8	—	3	3	1	1	→					—	8				

Exhibit IV-4-1. LISTING BOOK (PROVINCES), FORM A-2a, FOR PSU 19 IN RANCHI DISTRICT, RAJPUR PROVINCE--Continued

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Line No.	Road name or No.	Name of head of household and location or description of housing unit	Does any member of this household – Grow any crops of any kind–field, garden, or tree crops, etc. (now or at any time during 1971)?	Keep any livestock or poultry (now or at any time during 1971)?	What is the name of each member of this household who operates (has charge of) an agricultural holding? (Use a separate line for each such member, beginning with column 6, for partners in same household, however, use only one line.)	How does this person operate the holding – on own account, in partnership, as hired manager or chieftain? (Mark as many as applicable)	How much land does this person have–including cropland, pastureland, woodland, etc.? Do NOT include land rented out or land operated by others. For partnership, report total amount of land – not just your share. (Enter X in column 8 or amount in column 9, 10, 11, or 12.) Under 1/10 hectare	1/10 to 49 hectares	50 to 99 hectares	100 to 199 hectares	200 or more hectares	What is the name of this holding?	On how much land did you grow . . . at any time during 1971? (See inside front cover) (hectares)	How many cattle and calves of all ages are now on this holding – including those on common or public land it owned [by you] [by your employer] [jointly by your tribe or clan]?	Respondent	FOR SUPERVISOR'S USE Date listing approved	FOR SUPERVISOR'S USE National Certainty holding YES	FOR SUPERVISOR'S USE National Certainty holding NO	FOR SUPERVISOR'S USE Preliminary A-1a No.	FOR ENUMERATOR'S USE Date A-1a completed	FOR SUPERVISOR'S USE Date A-1a approved	NOTES (Explanations, callback information, instructions, etc.)
(1)	(2)	(3)	(4) (If NO in both columns 4 and 5, skip to 16)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(18)	(19)	(20)	(21)	(22)
1	Road J	Name of head Vacant Location of unit unpainted wood, For sale sign on house.	☐ Yes ☐ No	☐ Yes ☐ No		☐ On own account ☐ In partnership ☐ As hired manager or chieftain							/10 /10 /10		☐ Head ☐ Wife ☐ Other relative ☐ Other (Specify)							X
2	Road A	Name of head Juan Mateo Location of unit corner Road A and Adumko Road.	☒ Yes ☐ No	☐ Yes ☒ No	Juan Mateo	☒ On own account ☐ In partnership ☐ As hired manager or chieftain		21				—	10 -/10 /10 /10	—	☐ Head ☒ Wife ☐ Other relative ☐ Other (Specify)			X				X ·
3	Adumko Road	Name of head Elene Alamos Location of unit small stucco, unpainted. On left side	☒ Yes ☐ No	☐ Yes ☒ No	Juan Alamos	☒ On own account ☐ In partnership ☐ As hired manager or chieftain				175		—	170 -/10 /10 /10	—	☐ Head ☒ Wife ☐ Other relative ☐ Other (Specify)			X				X
4		Name of head Tamul Akerele Location of unit red brick, black roof. On left side.	☐ Yes ☒ No	☐ Yes ☒ No		☐ On own account ☐ In partnership ☐ As hired manager or chieftain							/10 /10 /10		☒ Head ☐ Wife ☐ Other relative ☐ Other (Specify)							X
5		Name of head Solabi Akbari Location of unit mud brick thatched roof. On right side	☒ Yes ☐ No	☒ Yes ☐ No	Solabi Akbari	☒ On own account ☐ In partnership ☐ As hired manager or chieftain					271	High-Grain Farm	200 -/10 /10 /10	53	☐ Head ☒ Wife ☐ Other relative ☐ Other (Specify)			X	14			X
6		Name of head Yussaf Akpan Location of unit gray stone, white roof. Fence in front. On right side	☒ Yes ☐ No	☒ Yes ☐ No	Yussaf Akpan	☒ On own account ☐ In partnership ☐ As hired manager or chieftain		22				—	20 -/10 /10 /10	–	☒ Head ☐ Wife ☐ Other relative ☐ Other (Specify)			X				X
7		Name of head Jeffery Biskar Location of unit large 2-story stone. On left side.	☒ Yes ☐ No	☒ Yes ☐ No	Jeffery Biskar	☒ On own account ☐ In partnership ☐ As hired manager or chieftain		47				—	30 -/10 /10 /10	–	☒ Head ☐ Wife ☐ Other relative ☐ Other (Specify)			X				X
8	Unnamed Road	Name of head Peter Dueno Location of unit small stone house at end of road.	☒ Yes ☐ No	☐ Yes ☒ No	Bill Dueno	☒ On own account ☐ In partnership ☐ As hired manager or chieftain		12				—	12 -/10 /10 /10	—	☒ Head ☐ Wife ☐ Other relative ☐ Other (Specify)			X	15			X Language difficulties
9	Concrato Road	Name of head Alfredo Mateo Location of unit cinder-block house, thatched roof.	☒ Yes ☐ No	☒ Yes ☐ No	Alfredo Mateo	☐ On own account ☒ In partnership ☐ As hired manager or chieftain		32				—	/10 5 -/10 /10	10	☒ Head ☐ Wife ☐ Other relative ☐ Other (Specify)			X				X
10		Name of head Alonso Mateo Location of unit red brick, black tarpaper roof	☒ Yes ☐ No	☒ Yes ☐ No	Alonso Mateo	☒ On own account ☐ In partnership ☐ As hired manager or chieftain		41				—	2 -/10 /10 /10	25	☐ Head ☐ Wife ☒ Other relative ☐ Other (Specify)			X				X
TOTAL ENTRIES (Including wavy-line entries) →						8	–	6	–	1	1	→					–	8				

Exhibit IV-4-1. LISTING BOOK (PROVINCES), FORM A-2a, FOR PSU 19 IN RANCHI DISTRICT, RAJPUR PROVINCE--Continued

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Line No.	Road name or No.	Name of head of household and location or description of housing unit	Does any member of this household —		What is the name of each member of this household who operates (has charge of) an agricultural holding? (Use a separate line for each such member, beginning with column 6; for partners in same household, however, use only one line.)	How does this person operate the holding — on own account, in partnership, as hired manager or chieftain? (Mark as many as applicable)	How much land does this person have—including cropland, pastureland, woodland, etc.? Do NOT include land rented out or land operated by others. For partnership, report total amount of land – not just your share. (Enter X in column 8 or amount in column 9, 10, 11, or 12.)					What is the name of this holding?	On how much land did you grow . . . at any time during 1971? (See inside front cover) (hectares)	How many cattle and calves of all ages are now on this holding – including those on common or public land if owned [by you] [by your employer] [jointly by your tribe or clan]?	Respondent	FOR SUPERVISOR'S USE				FOR ENUMERATOR'S USE	FOR SUPERVISOR'S USE	NOTES (Explanations, callback information, instructions, etc.)
			Grow any crops of any kind—field, garden, or tree crops, etc. (now or at any time during 1971)?	Keep any livestock or poultry (now or at any time during 1971)?			Under 1/10 hectare	1/10 to 49 hectares	50 to 99 hectares	100 to 199 hectares	200 or more hectares					Date listing approved	National Certainty holding (18)		Preliminary A-1a No.	Date A-1a completed	Date A-1a approved	
(1)	(2)	(3)	(If NO in both columns 4 and 5, skip to 16) (4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	YES	NO	(19)	(20)	(21)	(22)
1	Conocoto Road	Name of head Cristin Rene Location of unit small mud brick house. On right side	☒ Yes ☐ No	☐ Yes ☒ No	Cristin Rene	☒ On own account ☐ In partnership ☐ As hired manager or chieftain			73			—	16 - /10 /10 /10		☒ Head ☐ Wife ☐ Other relative ☐ Other (Specify)			X				X
2		Name of head Otto Burger Location of unit Large wood 2-story, white. Right side of road.	☒ Yes ☐ No	☒ Yes ☐ No	Otto Burger	☒ On own account ☐ In partnership ☒ As hired manager or chieftain				127 180		— Bilo's, Inc.	27 5/10 /10 180 - /10	25 —	☒ Head ☐ Wife ☐ Other relative ☐ Other (Specify)			X X				X X
3		Name of head Frederick Parsons Location of unit red brick, white roof and trim. On right side of road.	☒ Yes ☐ No	☒ Yes ☐ No	Fred Parsons	☒ On own account ☒ In partnership ☐ As hired manager or chieftain		10			(232)	The Parsonage	— /10 200 — /10 /10	— 10	☒ Head ☐ Wife ☐ Other relative ☐ Other (Specify)			X X	16			X X Partnership with son who lives elsewhere
4		Name of head Peter Cistario Location of unit northeast corner Conocoto Road and Pak Lane.	☒ Yes ☐ No	☐ Yes ☒ No	Dom Cistario	☒ On own account ☐ In partnership ☐ As hired manager or chieftain			52			—	15 - /10 /10 /10		☒ Head ☐ Wife ☐ Other relative ☐ Other (Specify)			X				X
5	Pak Lane	Name of head Alfredo Acosta Location of unit gray stucco with black roof. On right side.	☒ Yes ☐ No	☒ Yes ☐ No	Ramon Acosta	☒ On own account ☐ In partnership ☐ As hired manager or chieftain		(48)				—	30 — /10 /10 /10	—	☐ Head ☒ Wife ☐ Other relative ☐ Other (Specify)			X	17			X
6		Name of head Carlos Madera Location of unit gray stucco, white fence in front. On left side	☒ Yes ☐ No	☐ Yes ☒ No	Carlos Madera	☒ On own account ☐ In partnership ☐ As hired manager or chieftain				(110)		—	100 - /10 /10 /10	—	☐ Head ☒ Wife ☐ Other relative ☐ Other (Specify)			X	18			X
7		Name of head Jacob Alafoginis Location of unit small mud brick house. On right side of road.	☐ Yes ☒ No	☐ Yes ☒ No	—	☐ On own account ☐ In partnership ☐ As hired manager or chieftain							/10 /10 /10		☒ Head ☐ Wife ☐ Other relative ☐ Other (Specify)							X
8	Ilyas Road	Name of head Dennis Aldo Location of unit at bend in road about 1 kilometer from Pak Lane.	☐ Yes ☒ No	☐ Yes ☒ No	—	☐ On own account ☐ In partnership ☐ As hired manager or chieftain							/10 /10 /10		☒ Head ☐ Wife ☐ Other relative ☐ Other (Specify)							X
9		Name of head Hector Villa Location of unit house at end of road.	☒ Yes ☐ No	☒ Yes ☐ No	Hector Villa	☒ On own account ☐ In partnership ☐ As hired manager or chieftain			(78)			—	50 - /10 /10 /10	5	☐ Head ☒ Wife ☐ Other relative ☐ Other (Specify)			X	19			X
10	Pak Lane	Name of head Antonio DeVillant Location of unit Small red brick, white porch in front. On left side.	☒ Yes ☐ No	☒ Yes ☐ No	Art DeVillant	☒ On own account ☐ In partnership ☐ As hired manager or chieftain					(252)	—	200 — /10 /10 /10	15	☒ Head ☐ Wife ☐ Other relative ☐ Other (Specify)			X	20			X
TOTAL ENTRIES (Including wavy-line entries) →						10	–	2	3	3	2	→					–	10				

Exhibit IV-4-1. LISTING BOOK (PROVINCES), FORM A-2a, FOR PSU 19 IN RANCHI DISTRICT, RAJPUR PROVINCE--Continued

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Line No. (1)	Road name or No. (2)	Name of head of household and location or description of housing unit (3)	Does any member of this household – Grow any crops of any kind—field, garden, or tree crops, etc. (now or at any time during 1971)? (If NO in both columns 4 and 5, skip to 16) (4)	Keep any livestock or poultry (now or at any time during 1971)? (5)	What is the name of each member of this household who operates (has charge of) an agricultural holding? (Use a separate line for each such member, beginning with column 6, for partners in same household, however, use only one line.) (6)	How does this person operate the holding – on own account, in partnership, as hired manager or chieftain? (Mark as many as applicable) (7)	How much land does this person have—including cropland, pastureland, woodland, etc.? Do NOT include land rented out or land operated by others. For partnership, report total amount of land – not just your share. (Enter X in column 8 or amount in column 9, 10, 11, or 12.) Under 1/10 hectare (8)	1/10 to 49 hectares (9)	50 to 99 hectares (10)	100 to 199 hectares (11)	200 or more hectares (12)	What is the name of this holding? (13)	On how much land did you grow . . . at any time during 1971? (See inside front cover) (hectares) (14)	How many cattle and calves of all ages are now on this holding – including those on common or public land if owned [by you] [by your employer] [jointly by your tribe or clan]? (15)	Respondent (16)	FOR SUPERVISOR'S USE: Date listing approved (17)	National Certainty holding (18) YES	(18) NO	Preliminary A-1a No. (19)	FOR ENUMERATOR'S USE: Date A-1a completed (20)	FOR SUPERVISOR'S USE: Date A-1a approved (21)	NOTES (Explanations, callback information, instructions, etc.) (22)
1	Unnamed Road	Name of head Vacant Location of unit first house on left.	☐ Yes ☐ No	☐ Yes ☐ No		☐ On own account ☐ In partnership ☐ As hired manager or chieftain							/10 /10 /10		☐ Head ☐ Wife ☐ Other relative ☐ Other (Specify)	17 Jan						X
2		Name of head Joseph Abraham Location of unit house at end of trail.	☐ Yes ☒ No	☒ Yes ☐ No	George Abraham	☒ On own account ☐ In partnership ☐ As hired manager or chieftain		3				—	— /10 /10 /10	—	☒ Head ☐ Wife ☐ Other relative ☐ Other (Specify)	17 Jan		X				X
3		Name of head Edward Chung Location of unit small stucco house at end of unnamed road.	☐ Yes ☒ No	☒ Yes ☐ No	Edward Chung	☒ On own account ☒ In partnership ☐ As hired manager or chieftain		17	57			Chung and Sons	— /10 — /10 /10	10 25	☒ Head ☐ Wife ☐ Other relative ☐ Other (Specify)			X X				X X Partnership with two brothers who live elsewhere
4	Pak Lane	Name of head Merle Nelle Location of unit first house from unnamed road on right	☒ Yes ☐ No	☒ Yes ☐ No	Merle Nelle Dick Nelle	☐ On own account ☒ In partnership ☐ As hired manager or chieftain		16				—	/10 16 /10 /10	—	☒ Head ☐ Wife ☐ Other relative ☐ Other (Specify)			X				X
5		Name of head Eric Vanderson Location of unit at intersection of Hazard Trail and Pak Lane	☒ Yes ☐ No	☒ Yes ☐ No	Eric Vanderson	☒ On own account ☐ In partnership ☐ As hired manager or chieftain		⑭				—	10 /10 /10 /10	—	☒ Head ☐ Wife ☐ Other relative ☐ Other (Specify)			X	21			X
6		Name of head Arturo Corsillo Location of unit green stucco on right side of road	☒ Yes ☐ No	☐ Yes ☒ No	Arturo Corsillo	☒ On own account ☐ In partnership ☐ As hired manager or chieftain		31				—	31 /10 /10 /10	—	☒ Head ☐ Wife ☐ Other relative ☐ Other (Specify)			X				X
7	Kanpur Road	Name of head Jose Sanchez Location of unit grey stone with wire fence in front	☒ Yes ☐ No	☒ Yes ☐ No	Jose Sanchez Juan Sanchez	☐ On own account ☒ In partnership ☐ As hired manager or chieftain		5				—	/10 — /10 /10	1	☒ Head ☐ Wife ☐ Other relative ☐ Other (Specify)			X				X
8		Name of head Phillip Nebo Location of unit mud brick, thatched roof On right side	☐ Yes ☒ No	☐ Yes ☒ No		☐ On own account ☐ In partnership ☐ As hired manager or chieftain							/10 /10 /10		☐ Head ☒ Wife ☐ Other relative ☐ Other (Specify)							X
9		Name of head Richard Bolos Location of unit unpainted asphalt shingle, on right side	☐ Yes ☒ No	☒ Yes ☐ No	Richard Bolos John Bolos	☐ On own account ☒ In partnership ☐ As hired manager or chieftain		5				—	/10 — /10 /10	1	☒ Head ☐ Wife ☐ Other relative ☐ Other (Specify)			X				X
10	Hazard Trail	Name of head George Isaacs Location of unit first house on right.	☒ Yes ☐ No	☒ Yes ☐ No	George Isaacs	☒ On own account ☐ In partnership ☐ As hired manager or chieftain		⑤				—	2 2/10 /10 /10	1	☒ Head ☐ Wife ☐ Other relative ☐ Other (Specify)			X	22			X
TOTAL ENTRIES (Including wavy-line entries) →						9	–	8	1	–	–	→					–	9				

Exhibit IV-4-1. LISTING BOOK (PROVINCES), FORM A-2a, FOR PSU 19 IN RANCHI DISTRICT, RAJPUR PROVINCE--Continued

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Line No. (1)	Road name or No. (2)	Name of head of household and location or description of housing unit (3)	Does any member of this household – Grow any crops of any kind—field, garden, or tree crops, etc. (now or at any time during 1971)? (If NO in both columns 4 and 5, skip to 16) (4)	Keep any livestock or poultry (now or at any time during 1971)? (5)	What is the name of each member of this household who operates (has charge of) an agricultural holding? (Use a separate line for each such member, beginning with column 6, for partners in same household, however, use only one line.) (6)	How does this person operate the holding – on own account, in partnership, as hired manager or chieftain? (Mark as many as applicable) (7)	How much land does this person have—including cropland, pastureland, woodland, etc.? Do NOT include land rented out or land operated by others. For partnership, report total amount of land – not just your share. (Enter X in column 8 or amount in column 9, 10, 11, or 12.) Under 1/10 hectare (8)	1/10 to 49 hectares (9)	50 to 99 hectares (10)	100 to 199 hectares (11)	200 or more hectares (12)	What is the name of this holding? (13)	On how much land did you grow . . . at any time during 1971? (See inside front cover) (hectares) (14)	How many cattle and calves of all ages are now on this holding – including those on common or public land if owned [by you] [by your employer] [jointly by your tribe or clan]? (15)	Respondent (16)	FOR SUPERVISOR'S USE: Date listing approved (17)	National Certainty holding (18) YES	NO	Preliminary A-1a No. (19)	FOR ENUMERATOR'S USE: Date A-1a completed (20)	FOR SUPERVISOR'S USE: Date A-1a approved (21)	NOTES (Explanations, callback information, instructions, etc.) (22)
1	Hagard Trail	Name of head Mohmed Shastry Location of unit grey stone house, shed in rear.	☒ Yes ☐ No	☒ Yes ☐ No	Mohmed Shastry	☒ On own account ☐ In partnership ☐ As hired manager or chieftain				102		—	75 — /10 /10 /10	—	☒ Head ☐ Wife ☐ Other relative ☐ Other (Specify)	17 Jan		X				
2		Name of head Robert Jung Location of unit mud brick house, wire fence in front	☐ Yes ☒ No	☒ Yes ☐ No	Robert Jung	☒ On own account ☐ In partnership ☐ As hired manager or chieftain		10				—	— /10 /10 /10	—	☐ Head ☒ Wife ☐ Other relative ☐ Other (Specify)			X				
3	Kanpur Road	Name of head Bruce Oberman Location of unit grey stone house, brown roof.	☒ Yes ☐ No	☐ Yes ☒ No	Bill Oberman	☒ On own account ☐ In partnership ☐ As hired manager or chieftain		14				—	— /10 /10 /10	—	☐ Head ☒ Wife ☐ Other relative ☐ Other (Specify)			X				
4		Name of head Dominic Sanchez Location of unit White frame with black roof. On right side.	☒ Yes ☐ No	☒ Yes ☐ No	Dominic Sanchez	☒ On own account ☒ In partnership ☐ As hired manager or chieftain			71	110		— —	— /10 — /10 /10	2 3	☒ Head ☐ Wife ☐ Other relative ☐ Other (Specify)			X X				
5	Kanpur Road	Name of head Edmundo Otero Location of unit thatched hut with thatched roof. On left side.	☒ Yes ☐ No	☒ Yes ☐ No	Roberto Otero	☒ On own account ☐ In partnership ☐ As hired manager or chieftain		18				—	10 — /10 /10 /10	—	☒ Head ☐ Wife ☐ Other relative ☐ Other (Specify)			X				
6		Name of head Gerald Obi Location of unit white stucco, thatched roof. On left side	☐ Yes ☒ No	☐ Yes ☒ No		☐ On own account ☐ In partnership ☐ As hired manager or chieftain							/10 /10 /10		☒ Head ☐ Wife ☐ Other relative ☐ Other (Specify)							
7		Name of head Gregorio Algosa Location of unit white stucco. Corrugated steel roof. On left side.	☐ Yes ☒ No	☒ Yes ☐ No	Gregorio Algosa	☒ On own account ☐ In partnership ☐ As hired manager or chieftain		⑤				—	— /10 /10 /10	—	☒ Head ☐ Wife ☐ Other relative ☐ Other (Specify)			X	23			
8		Name of head Hamid Ali Location of unit unpainted stucco, grey roof. On left side.	☒ Yes ☐ No	☒ Yes ☐ No	Hamid Ali	☒ On own account ☐ In partnership ☐ As hired manager or chieftain				178		Ali Brothers	150 /10 /10 /10	—	☐ Head ☐ Wife ☒ Other relative ☐ Other (Specify)			X				
9	Harto Road	Name of head Michael Tehrani Location of unit first house on right.	☒ Yes ☐ No	☒ Yes ☐ No	Michael Tehrani	☒ On own account ☐ In partnership ☐ As hired manager or chieftain			78			—	15 — /10 /10 /10	—	☐ Head ☐ Wife ☒ Other relative ☐ Other (Specify)			X				
10		Name of head Neil Thayer Location of unit house at end of road.	☐ Yes ☒ No	☐ Yes ☒ No		☐ On own account ☐ In partnership ☐ As hired manager or chieftain							/10 /10 10		☒ Head ☐ Wife ☐ Other relative ☐ Other (Specify)	17 Jan						
		TOTAL ENTRIES (Including wavy-line entries) →				9	—	4	2	3	—	→					—	9				

Exhibit IV-4-1. LISTING BOOK (PROVINCES), FORM A-2a, FOR PSU 19 IN RANCHI DISTRICT, RAJPUR PROVINCE--Continued

Page 10

Line No. (1)	Road name or No. (2)	Name of head of household and location or description of housing unit (3)	Does any member of this household – Grow any crops of any kind—field, garden, or tree crops, etc. (now or at any time during 1971)? (4)	Keep any livestock or poultry (now or at any time during 1971)? (5) (If NO in both columns 4 and 5, skip to 16)	What is the name of each member of this household who operates (has charge of) an agricultural holding? (Use a separate line for each such member, beginning with column 6, for partners in same household, however, use only one line.) (6)	How does this person operate the holding – on own account, in partnership, as hired manager or chieftain? (Mark as many as applicable) (7)	How much land does this person have—including cropland, pastureland, woodland, etc.? Do NOT include land rented out or land operated by others. For partnership, report total amount of land – not just your share. (Enter X in column 8 or amount in column 9, 10, 11, or 12.) Under 1/10 hectare (8)	1/10 to 49 hectares (9)	50 to 99 hectares (10)	100 to 199 hectares (11)	200 or more hectares (12)	What is the name of this holding? (13)	On how much land did you grow . . . at any time during 1971? (See inside front cover) (hectares) (14)	How many cattle and calves of all ages are now on this holding – including those on common or public land if owned [by you] [by your employer] [jointly by your tribe or clan]? (15)	Respondent (16)	FOR SUPERVISOR'S USE: Date listing approved (17)	National Certainty holding (18) YES	NO	Preliminary A-1a No. (19)	FOR ENUMERATOR'S USE: Date A-1a completed (20)	FOR SUPERVISOR'S USE: Date A-1a approved (21)	HOTES (Explanations, callback information, instructions, etc.) (22)
1	Kanpur Road.	Name of head Pedro Martinas Location of unit first house on left from Harto Road	☒ Yes ☐ No	☒ Yes ☐ No	Pedro Martinas Jose Martinas	☒ On own account ☒ In partnership ☐ As hired manager or chieftain		10			(205)	— Breton Farms	10 -/10 — /10 /10	— 150	☒ Head ☐ Wife ☐ Other relative ☐ Other (Specify)	17 Jan		X X	 24			X X
2	Unnamed road (leads to private ranch)	Name of head Victoria Gonzales Location of unit at corner of Concreto Rd and private road	☒ Yes ☐ No	☐ Yes ☒ No	Victoria Gonzales	☒ On own account ☐ In partnership ☐ As hired manager or chieftain			(51)			—	50 -/10 /10 /10	—	☐ Head ☒ Wife ☐ Other relative ☐ Other (Specify)			X	25			X
3		Name of head Allen Rooks Location of unit first house on left - gray stone.	☐ Yes ☒ No	☒ Yes ☐ No	Allen Rooks	☒ On own account ☐ In partnership ☐ As hired manager or chieftain					(257)	High Acre Farm	— /10 /10 /10	75	☒ Head ☐ Wife ☐ Other relative ☐ Other (Specify)			X	26			X
4		Name of head Francisco Vila Location of unit red brick, green roof. On right side	☒ Yes ☐ No	☒ Yes ☐ No	Francisco Vila	☒ On own account ☐ In partnership ☐ As hired manager or chieftain		32				—	10 5/10 /10 /10	—	☒ Head ☐ Wife ☐ Other relative ☐ Other (Specify)			X				X
5		Name of head Raphael Ruccio Location of unit white stucco, thatched roof.	☒ Yes ☐ No	☒ Yes ☐ No	Paul Ruccio	☒ On own account ☐ In partnership ☐ As hired manager or chieftain		41				—	35 3/10 /10 /10	5	☒ Head ☐ Wife ☐ Other relative ☐ Other (Specify)			X				X
6		Name of head Antonio Villa Location of unit large red brick 2-story. Fence in front.	☒ Yes ☐ No	☒ Yes ☐ No	Antonio Villa	☐ On own account ☐ In partnership ☒ As hired manager or chieftain					3500	Las Mariannas Ranch	/10 /10 3 5/10	—	☒ Head ☐ Wife ☐ Other relative ☐ Other (Specify)		X					X
7		Name of head Gilberto Costa Location of unit gray stone, shed in back.	☐ Yes ☒ No	☒ Yes ☐ No	Ramon Costa	☒ On own account ☐ In partnership ☐ As hired manager or chieftain		(16)				—	— /10 /10 /10	—	☒ Head ☐ Wife ☐ Other relative ☐ Other (Specify)			X	27			X
8		Name of head Alexander Kalaris Location of unit mud brick, thatched roof.	☒ Yes ☐ No	☒ Yes ☐ No	Alexander Kalaris	☒ On own account ☐ In partnership ☐ As hired manager or chieftain		12				—	— /10 /10 /10	—	☒ Head ☐ Wife ☐ Other relative ☐ Other (Specify)			X				X
9		Name of head Gordon Roscoe Location of unit green painted stucco, green roof.	☒ Yes ☐ No	☒ Yes ☐ No	James Roscoe	☒ On own account ☐ In partnership ☐ As hired manager or chieftain		7				—	— /10 /10 /10	—	☐ Head ☒ Wife ☐ Other relative ☐ Other (Specify)	17 Jan		X				X
10		Name of head Location of unit	☐ Yes ☐ No	☐ Yes ☐ No		☐ On own account ☐ In partnership ☐ As hired manager or chieftain							/10 /10 /10		☐ Head ☐ Wife ☐ Other relative ☐ Other (Specify)							
TOTAL ENTRIES (Including wavy-line entries) →						10	-	6	1	-	3	→					1	9				

Exhibit IV-4-1. LISTING BOOK (PROVINCES), FORM A-2a, FOR PSU 19 IN RANCHI DISTRICT, RAJPUR PROVINCE--Continued

SUMMARY OF PAGE TOTALS

Page No.	Total holdings — Column 7	On each line, sum of columns 8 through 12 must equal column 7					National Certainty holdings — YES in column 18	On each line, sum of columns 8 through 12 must equal figure for YES in column 18					On each line, figure for NO in 18 plus figure for YES in 18 must equal column 7
								YES in column 18 and entry in –					
		Column 8	Column 9	Column 10	Column 11	Column 12		Column 8	Column 9	Column 10	Column 11	Column 12	NO in column 18
1	10	1	7	1	1	–	–	–	-	-	–	–	10
2	10	–	8	1	1	–	–	–	–	–	–	-	10
3	6	3	1	1	-	1	–	–	-	–	–	–	6
4	9	–	5	1	1	2	–	–	–	–	–	-	9
5	8	–	3	3	1	1	-	–	–	–	-	–	8
6	8	–	6	-	1	1	-	–	–	–	–	–	8
7	10	–	2	3	3	2	–	–	-	–	-	-	10
8	9	–	8	1	-	-	-	–	–	–	–	-	9
9	9	-	4	2	3	–	-	–	–	–	–	–	9
10	10	-	6	1	-	3	1	–	-	–	–	1	9
11													
12													
13													
14													
15													
16													
PSU TOTAL	89	4	50	14	11	10	1	–	-	–	-	1	
	Transcribe to line (h) on front cover						Transcribe to line (i) on front cover						

NOTES

GPO 1968 O - 293-085

Exhibit IV-5-1. PRELIMINARY COUNT: CHIEFDOMS BY SIZE GROUPS, FOR THE NORTHERN TERRITORY: 1970

Zone	Number of territorial districts	Population, 1 May 1970	Number of chiefdoms							Average number of persons per chiefdom
			Total	With population--						
				Under 100	100 to 299	300 to 599	600 to 999	1,000 to 3,499	3,500 or more	
Total	18	380,802	1,879	650	1,018	186	11	9	5	203
Atbara River Basin	8	158,584	776	297	363	103	6	4	3	204
Northwest	6	130,382	659	201	400	52	3	2	1	198
Subic Mountains	4	91,836	444	152	255	31	2	3	1	207

Source: 1970 Census of Population.

Exhibit IV-5-2. PRELIMINARY POPULATION COUNT: SPECIAL ENUMERATION AREAS BY SIZE GROUPS, FOR THE NORTHERN TERRITORY: 1970

Zone	Population, 1 May 1970	Number of special EA's							Average number of persons per special EA
		Total	With population--						
			Under 100	100 to 299	300 to 599	600 to 999	1,000 to 3,499	3,500 or more	
Total	14,299	73	22	39	12	-	-	-	196
Atbara River Basin	7,449	37	13	16	8	-	-	-	201
Northwest	2,397	12	5	4	3	-	-	-	200
Subic Mountains	4,453	24	4	19	1	-	-	-	186

- Entry represents zero.

Source: 1970 Census of Population.

Exhibit IV-5-3. PRELIMINARY POPULATION COUNT: URBAN ENUMERATION AREAS BY SIZE GROUPS, FOR THE NORTHERN TERRITORY: 1970

Zone	Urban population, 1 May 1970	Number of urban EA's 1970								Average number of persons per urban EA
		Total	With population--							
			Under 500	500 to 599	600 to 699	700 to 799	800 to 899	900 to 999	1,000 or more	
Total	34,979	34	1	1	2	2	10	12	6	1,029
Atbara River Basin	26,825	25	-	1	2	2	7	9	4	1,073
Northwest	5,739	6	-	-	-	-	3	2	1	957
Subic Mountains	2,415	3	1	-	-	-	-	1	1	805

- Entry represents zero.

Source: 1970 Census of Population.

Exhibit IV-5-4. ESTIMATED SAMPLE SIZE FOR THE NORTHERN TERRITORY

Population size group	Population, 1 May 1970 (preliminary count)			PSU's			PSU sampling rate	PSU's in sample	Population in sample PSU's	Housing units in sample PSU's (estimated number)
	Total for agriculture census (1)	Rural (2)	Urban (3)	Total (4)	Chiefdoms and Special EA's (5)	Urban (6)	(7)	(8)	(9)	(10)
Northern Territory....	407,279	395,101	12,178	1,969	1,952	17	(X)	101	46,485	8,460
Atbara River Basin........	170,057	166,033	4,024	821	813	8	(X)	44	23,386	4,255
Less than 300..............	93,196	93,196	-	689	689	-	1 in 24	29	3,983	725
300 to 699.................	49,655	46,509	3,146	120	113	7	1 in 12	10	4,237	770
700 to 1,499...............	6,967	6,089	878	6	5	1	1 in 6	1	1,089	200
1,500 to 3,499.............	8,775	8,775	-	3	3	-	1 in 3	1	2,613	475
3,500 or more..............	11,464	11,464	-	3	3	-	all	3	11,464	2,085
Northwest.................	138,518	132,779	5,739	677	671	6	(X)	33	12,849	2,340
Less than 300..............	100,099	100,099	-	610	610	-	1 in 24	25	4,062	740
300 to 799.................	22,667	21,918	749	57	56	1	1 in 12	5	2,001	365
800 to 999.................	5,394	1,726	3,668	6	2	4	1 in 6	1	852	155
1,000 to 3,499.............	6,632	5,310	1,322	3	2	1	1 in 3	1	2,208	400
3,500 or more..............	3,726	3,726	-	1	1	-	all	1	3,726	680
Subic Mountains...........	98,704	96,289	2,415	471	468	3	(X)	24	10,250	1,865
Less than 300..............	73,258	73,258	-	430	430	-	1 in 24	18	3,056	555
300 to 499.................	10,891	10,423	468	31	30	1	1 in 12	3	1,066	195
500 to 1,299...............	4,565	2,618	1,947	6	4	2	1 in 6	1	743	135
1,300 to 3,000.............	6,296	6,296	-	3	3	-	1 in 3	1	1,691	310
3,000 or more..............	3,694	3,694	-	1	1	-	all	1	3,694	670

Population size group	All holdings in sample PSU's (estimated number)			Within PSU sampling rate	Overall sampling rate	Holdings in sample (estimated number)			Holdings in sample for area measurement
	Total (11)	Small (12)	National Certainty (13)	(14)	(15)	Total (16)	Small (17)	National Certainty (18)	(19)
Northern Territory....	8,035	7,930	105	(X)	1 in 48	1,565	1,460	105	370
Atbara River Basin........	4,045	3,985	60	(X)	1 in 48	670	610	60	155
Less than 300..............	690	680	10	1 in 2	1 in 48	350	340	10	85
300 to 699.................	730	720	10	1 in 4	1 in 48	190	180	10	45
700 to 1,499...............	190	175	15	1 in 8	1 in 48	35	20	15	5
1,500 to 3,499.............	455	440	15	1 in 16	1 in 48	45	30	15	10
3,500 or more..............	1,980	1,970	10	1 in 48	1 in 48	50	40	10	10
Northwest.................	2,220	2,190	30	(X)	1 in 48	525	495	30	125
Less than 300..............	705	700	5	1 in 2	1 in 48	355	350	5	90
300 to 799.................	350	340	10	1 in 4	1 in 48	95	85	10	20
800 to 999.................	145	140	5	1 in 8	1 in 48	25	20	5	5
1,000 to 3,499.............	380	375	5	1 in 16	1 in 48	30	25	5	5
3,500 or more..............	640	635	5	1 in 48	1 in 48	20	15	5	5
Subic Mountains...........	1,770	1,755	15	(X)	1 in 48	370	355	15	90
Less than 300..............	525	520	5	1 in 2	1 in 48	265	260	5	65
300 to 499.................	185	185	-	1 in 4	1 in 48	45	45	-	10
500 to 1,299...............	130	125	5	1 in 8	1 in 48	20	15	5	5
1,300 to 3,000.............	295	290	5	1 in 16	1 in 48	25	20	5	5
3,000 or more..............	635	635	-	1 in 48	1 in 48	15	15	-	5

(X) Not applicable. - Entry represents zero.

Column 1. Sum of columns 2 and 3.

Column 2. All EA's classified as rural.

Column 3. All of the urban EA's in Cebu and Ombo cities and 8 rural-like EA's in Zanzi.

Column 4. Sum of columns 5 and 6.

Column 5. Primary sampling units established for the 1971 Sample Census of Agriculture; equivalent to chiefdoms and Special EA's in the Population Census.

Column 6. Primary sampling units established for the 1971 Sample Census of Agriculture; equivalent to urban EA's in the Population Census in Cebu and Ombo cities and the 8 rural-like EA's in Zanzi.

Column 7. Rate used to sample PSU's within each population group.

Column 8. Number of PSU's selected from each population size group.

Column 9. Total population in the selected PSU's.

Column 10. Estimates based on average of 5.5 persons per housing unit.

Column 11. Assumes that about 95 percent of the housing units are associated with a holding.

Column 12. Holdings of less than 500 hectares.

Column 13. Holdings of 500 hectares or more or having specialized agricultural operations.

Column 14. Rate used to select the small holdings to be enumerated.

Column 15. The overall sampling rate for the Agriculture Questionnaire; equivalent to column 7 X column 14.

Column 16. Sum of columns 17 and 18; total number of Agriculture Questionnaires to be filled.

Column 17. Sample of small holdings, applying the sampling rate in column 14 to the estimate in column 12.

Column 18. Same as figure in column 8; all National Certainty holdings are to be enumerated.

Column 19. One-fourth of the estimate in column 17; area will be reported, but not measured, for all National Certainty holdings.

Exhibit IV-5-5. ENUMERATOR'S MAP SKETCH OF DAMASCUS CHIEFDOM IN THE NORTHERN TERRITORY

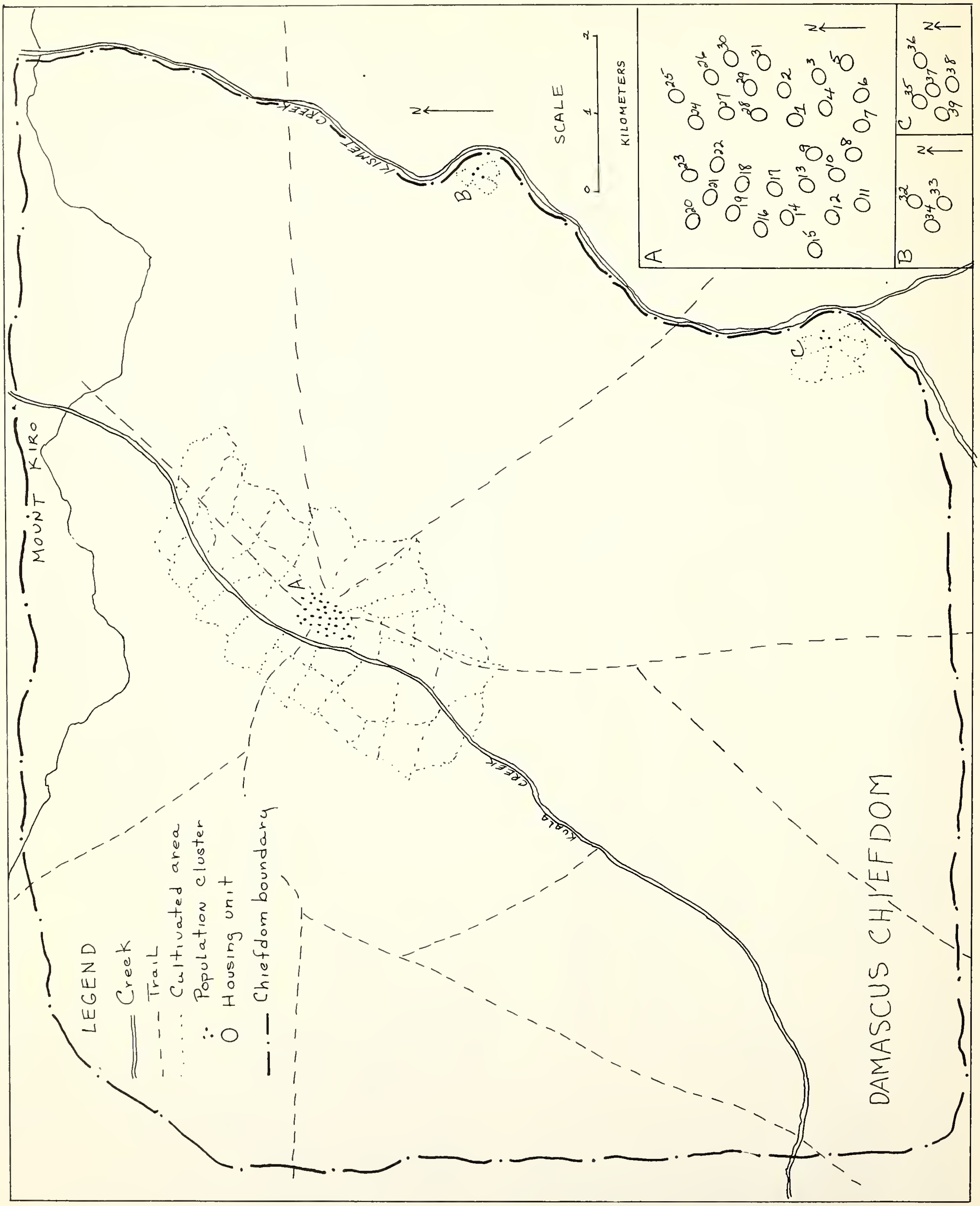
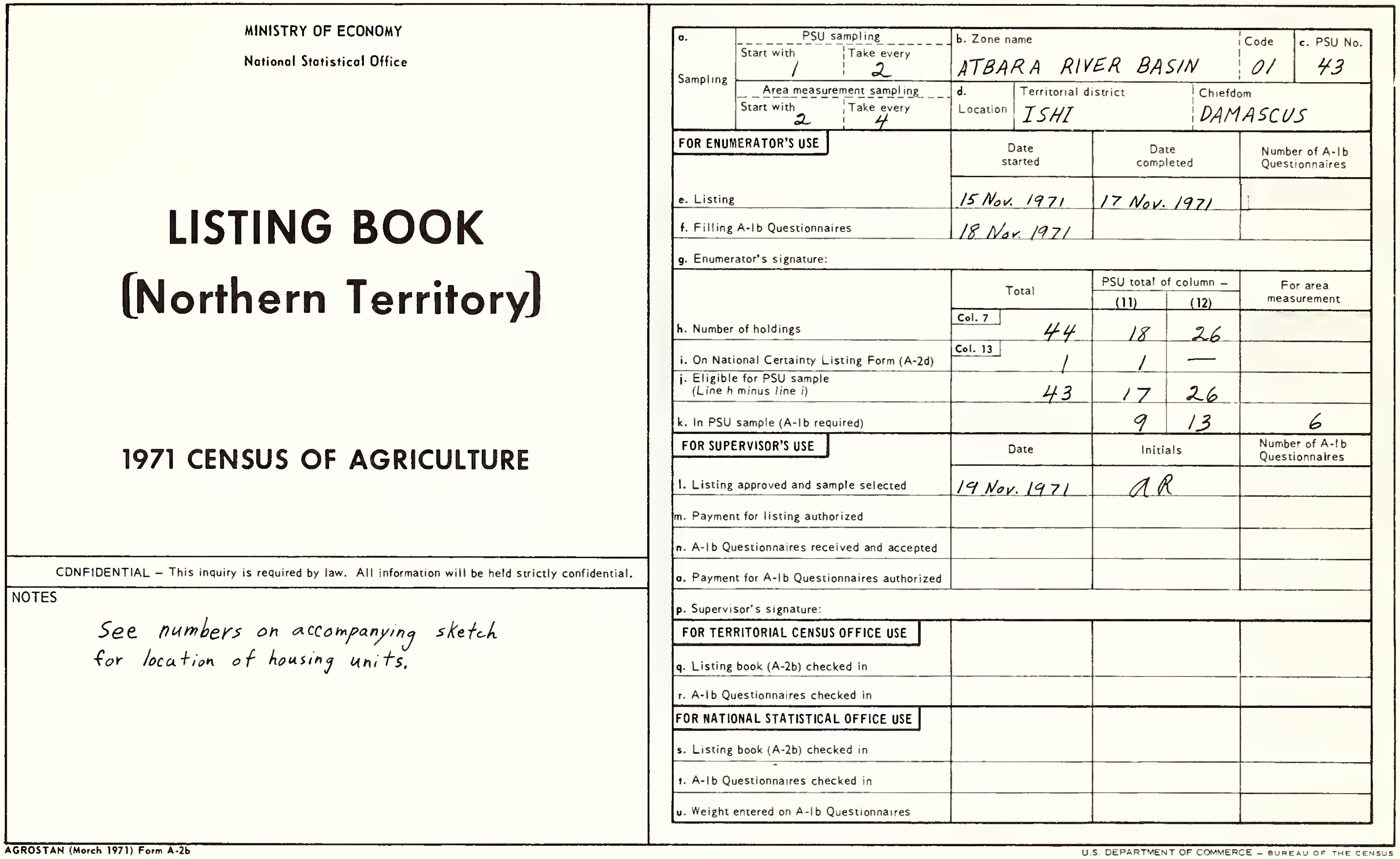


Exhibit IV-5-6. LISTING BOOK (NORTHERN TERRITORY), FORM A-2b, FOR DAMASCUS CHIEFDOM IN THE NORTHERN TERRITORY



MINISTRY OF ECONOMY
National Statistical Office

LISTING BOOK
(Northern Territory)

1971 CENSUS OF AGRICULTURE

CONFIDENTIAL – This inquiry is required by law. All information will be held strictly confidential.

NOTES

See numbers on accompanying sketch for location of housing units.

AGROSTAN (March 1971) Form A-2b

a.	PSU sampling		b. Zone name	Code	c. PSU No.
Sampling	Start with 1	Take every 2	ATBARA RIVER BASIN	01	43
	Area measurement sampling		d. Location	Territorial district	Chiefdom
	Start with 2	Take every 4		ISHI	DAMASCUS

FOR ENUMERATOR'S USE	Date started	Date completed	Number of A-1b Questionnaires
e. Listing	15 Nov. 1971	17 Nov. 1971	
f. Filling A-1b Questionnaires	18 Nov. 1971		

g. Enumerator's signature:

	Total	PSU total of column – (11)	(12)	For area measurement
h. Number of holdings	Col. 7 44	18	26	
i. On National Certainty Listing Form (A-2d)	Col. 13 1	1	—	
j. Eligible for PSU sample (Line h minus line i)	43	17	26	
k. In PSU sample (A-1b required)		9	13	6

FOR SUPERVISOR'S USE	Date	Initials	Number of A-1b Questionnaires
l. Listing approved and sample selected	19 Nov. 1971	AR	
m. Payment for listing authorized			
n. A-1b Questionnaires received and accepted			
o. Payment for A-1b Questionnaires authorized			

p. Supervisor's signature:

FOR TERRITORIAL CENSUS OFFICE USE			
q. Listing book (A-2b) checked in			
r. A-1b Questionnaires checked in			
FOR NATIONAL STATISTICAL OFFICE USE			
s. Listing book (A-2b) checked in			
t. A-1b Questionnaires checked in			
u. Weight entered on A-1b Questionnaires			

U.S. DEPARTMENT OF COMMERCE – BUREAU OF THE CENSUS

Exhibit IV-5-6. LISTING BOOK (NORTHERN TERRITORY), FORM A-2b, FOR DAMASCUS CHIEFDOM IN THE NORTHERN TERRITORY--Continued

STEPS FOR LISTING AND SAMPLING

1. Fill columns 1 through 10 for each holding.

2. As each page of listings is completed, fill columns 11, 12, and 13.

3. Add the entries for columns 7, 11, 12, and 13; then transcribe the totals to "Summary of Page Totals" on the inside back cover.

4. When entire PSU is listed, obtain the PSU totals in "Summary of Page Totals," then transcribe the totals to line (h) or (i) on the front cover. Complete line (j).

5. Select the sample of holdings from the "X" entries in columns 11 and 12 by applying the "start with" and "take every" figures for "PSU sampling" given in item (a) on the front cover. Apply the sampling pattern to the "X" entries in column 11 for the entire PSU, then continue the pattern for the "X" entries in column 12. Circle the "X" entry for each holding that falls in the sample.

6. Count the number of circled "X" entries in columns 11 and 12, respectively; then transcribe the totals for the PSU to line (k) on the front cover.

7. Check that the sum of columns 11 and 12 on line (k) agrees with the number of sample cases in the appropriate table (table 1, 2, 3, 4, or 5 in the Appendix of the Enumerator's Reference Manual).

8. Assign preliminary A-1b numbers to the holdings with circled "X" in column 11, then continue the numbering for the circled "X" holdings in column 12. Enter the A-1b numbers in columns 14 and 15, respectively.

9. Select the cases for area measurement by applying the "start with" and "take every" figures for "Area measurement sampling" given in item (a) on the front cover. Apply the sampling pattern to the A-1b numbers first in column 14 for the entire PSU, then continue the pattern in column 15. Circle all A-1b numbers for those holdings selected for area measurement. (Check with table 6 in Enumerator's Manual.)

WHEN TO FILL A-1b QUESTIONNAIRE

- Fill an A-1b questionnaire for all holdings which have been assigned an A-1b number in column 14 or 15.
- Do the "area measurement" for all holdings which have a circled A-1b number in column 14 or 15.

REMINDERS

Canvassing	Locate each housing unit within the PSU boundaries. List in systematic order. Follow each road or path to be sure you find all housing units. Indicate direction of travel on the PSU map.
Listing	List each household on a separate line of the Listing Book, and fill the appropriate columns. If the housing unit is vacant, write VACANT in the space for "Name of head" in column 3; enter "Location of unit" in column 3, and leave columns 4 to 19 blank. When each line is completed, enter "X" in column 20.
Callbacks	Make return visits when you cannot find a reliable respondent. Keep a record of callbacks in column 20.
"None" Entry	If "None" for column 8 or 9, enter a dash (–). Do not leave blank.
Housing Unit	House, hut, tent, room, or group of rooms occupied or intended for occupancy as separate living quarters by a family or other group of persons living together, or by a person living alone.
Household	The person or group of persons who occupy one housing unit. The household may include nonrelatives (such as lodgers, servants, hired hands).
Polygomous Husband	Husband with more than one wife. If the wives live with the husband in the same household, list the husband as head; if the wives live in separate households, list the husband with the first-married wife and consider him as the head. Consider the husband as the holder if he grows any crops or keeps any livestock.
Grow Crops	Refers to the seeding, planting, or caring of crops (now or at any time during 1971) with the intention of harvesting or selling them.
Keep Livestock	Refers to all livestock and poultry on the holding (now or at any time during 1971) regardless of ownership. Includes livestock owned by the holder if they are on common or public grazing land. Also includes bees, silkworms, rabbits and other fur-bearing animals in captivity on the holding.
Holding	Land which is used wholly or partly for agricultural production and is operated as a unit; that is, under the same management and with the same means of production (labor force, machinery, or animals). A holding may comprise more than one parcel of land.
Holder or Person in Charge	The person who makes the day-to-day decisions concerning the operations of a holding. The holder may do the work himself or he may supervise the work of others.
On Own Account	Holding operated by an individual or members of a household independently from any other holding or persons. The holder is not responsible to any other person(s) for the operations of the holding. The holder need not own the land.
In Partnership	Holding operated by two or more persons who share in the operations and the agricultural production of the holding. Partners may live in the same household or in separate households.
As Chieftain (Headman)	Holding operated by the administrative head or leader of a tribe or clan. The chieftain supervises tribal land which is not assigned to members.
As Hired Manager	Holding operated by a person who takes the responsibility for the operations of the holding. He makes the day-to-day decisions and either does the work himself or supervises the work of others, employing additional labor if necessary. He is generally paid a salary or may receive a share of the agricultural production. Do not confuse him with a hired man or caretaker who simply carries out his employer's instructions.

Exhibit IV-5-6. LISTING BOOK (NORTHERN TERRITORY), FORM A-2b, FOR DAMASCUS CHIEFDOM IN THE NORTHERN TERRITORY--Continued

Page 1

Line No.	Road name or No.	Name of head of household and location or description of housing unit (If female, determine if she is first of several wives; if so, list husband as holder)	Did any member of this household – Grow any crops of any kind—field, garden, or tree crops, etc., at any time during 1971?	Keep any livestock or poultry at any time during 1971? (If NO in both columns 4 and 5, skip to 10)	What is the name of each member of this household who operated (had charge of) an agricultural holding? (Use a separate line for each such member, beginning with column 6; for partners in same household, however, use only one line.)	How did this person operate the holding – on own account, in partnership, as chieftain, or hired manager? (Mark as many as applicable)	How many of the following animals are NOW on this holding – including those on common or public land if owned by you, jointly by your tribe or clan, by your employer – Cattle and calves of all ages? (If 25 or more, circle the entry)	Sheep and goats of all ages? (If 100 or more, circle the entry)	Respondent	PSU sampling – Enter "X" if entry – Circled in column 8 or 9	NOT circled in column 8 or 9	National Certainty holding (If YES, draw wavy line through columns 11 and 12) YES	NO	A-1b Questionnaire – Preliminary A-1b No. for circled "X" in – Column 11	Column 12	Date basic questionnaire completed	Date area measurement completed	FOR SUPERVISOR'S USE – Date listing approved	Date A-1b approved	NOTES (Explanations, callback information, instructions, etc.)
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)
1	KUALA CREEK	Name of head ELBAG PUERTO Location of unit No. 1	☒ Yes ☐ No	☒ Yes ☐ No	ELBAG PUERTO	☒ On own account ☐ In partnership ☒ As chieftain or hired manager	32 432	267 —	☒ Head ☐ Wife ☐ Other relative ☐ Other (Specify)	X X		 X	X	1		18/4		19/4/71		X
2		Name of head Location of unit	☐ Yes ☐ No	☐ Yes ☐ No	TARIZ PUERTO	☒ On own account ☐ In partnership ☐ As chieftain or hired manager	—	—	☒ Head ☐ Wife ☐ Other relative ☐ Other (Specify)		X		X							X
3		Name of head OMAR JAMIL Location of unit No. 2	☒ Yes ☐ No	☒ Yes ☐ No	OMAR JAMIL	☒ On own account ☐ In partnership ☐ As chieftain or hired manager	—	4	☒ Head ☐ Wife ☐ Other relative ☐ Other (Specify)		X		X		10	18/4	18/4			X
4		Name of head NOOR AHMED Location of unit No. 3	☒ Yes ☐ No	☒ Yes ☐ No	NOOR AHMED	☒ On own account ☐ In partnership ☐ As chieftain or hired manager	—	110	☐ Head ☐ Wife ☐ Other relative ☒ Other (Specify) Neighbor	X			X							X
5		Name of head MUSTAFA LAZRIG Location of unit No. 4	☒ Yes ☐ No	☒ Yes ☐ No	MUSTAFA LAZRIG	☐ On own account ☒ In partnership ☐ As chieftain or hired manager	30	75	☒ Head ☐ Wife ☐ Other relative ☐ Other (Specify)	X			X	2		18/4	19/4			X Call back in the evening. 17/11
6		Name of head UMAR PINTO Location of unit No. 5	☐ Yes ☒ No	☐ Yes ☒ No		☐ On own account ☐ In partnership ☐ As chieftain or hired manager			☐ Head ☐ Wife ☒ Other relative ☐ Other (Specify)											X
7		Name of head SIDDIQUE MUSSA Location of unit No. 6	☒ Yes ☐ No	☒ Yes ☐ No	SIDDIQUE MUSSA	☒ On own account ☐ In partnership ☐ As chieftain or hired manager	—	125	☐ Head ☒ Wife ☐ Other relative ☐ Other (Specify)	X			X							X
8		Name of head GORDO MANTIA Location of unit No. 7	☒ Yes ☐ No	☒ Yes ☐ No	GORDO MANTIA	☒ On own account ☐ In partnership ☐ As chieftain or hired manager	1	26	☒ Head ☐ Wife ☐ Other relative ☐ Other (Specify)		X		X							X
9		Name of head ABDUL USMAN Location of unit No. 8	☒ Yes ☐ No	☐ Yes ☒ No	ABDUL USMAN	☒ On own account ☐ In partnership ☐ As chieftain or hired manager	—	—	☒ Head ☐ Wife ☐ Other relative ☐ Other (Specify)		X		X		11					X
10		Name of head KHALID BIN WALID Location of unit No. 9	☒ Yes ☐ No	☒ Yes ☐ No	KHALID BIN WALID	☒ On own account ☐ In partnership ☐ As chieftain or hired manager	3	14	☒ Head ☐ Wife ☐ Other relative ☐ Other (Specify)		X		X							X
TOTAL ENTRIES (Including wavy-line entries.) →						10	→			5	5	1	9							

Exhibit IV-5-6. LISTING BOOK (NORTHERN TERRITORY), FORM A-2b, FOR DAMASCUS CHIEFDOM IN THE NORTHERN TERRITORY--Continued

Page 2

Line No. (1)	Road name or No. (2)	Name of head of household and location or description of housing unit (*If female, determine if she is first of several wives; if so, list husband as holder*) (3)	Did any member of this household – Grow any crops of any kind—field, garden, or tree crops, etc., at any time during 1971? (*If NO in both columns 4 and 5, skip to 10*) (4)	Did any member of this household – Keep any livestock or poultry at any time during 1971? (5)	What is the name of each member of this household who operated (had charge of) an agricultural holding? (*Use a separate line for each such member, beginning with column 6; for partners in same household, however, use only one line.*) (6)	How did this person operate the holding – on own account, in partnership, as chieftain, or hired manager? (*Mark as many as applicable*) (7)	How many of the following animals are NOW on this holding – including those on common or public land if owned [by you], [jointly by your tribe or clan], [by your employer] – Cattle and calves of all ages? (*If 25 or more, circle the entry*) (8)	Sheep and goats of all ages? (*If 100 or more, circle the entry*) (9)	Respondent (10)	PSU sampling – Enter "X" if entry – Circled in column 8 or 9 (11)	NOT circled in column 8 or 9 (12)	National Certainty holding (*If YES, draw wavy line through columns 11 and 12*) (13) YES	(13) NO	A-Ib Questionnaire – Preliminary A-Ib No. for circled "X" in – Column 11 (14)	Column 12 (15)	Date basic questionnaire completed (16)	Date area measurement completed (17)	FOR SUPERVISOR'S USE – Date listing approved (18)	Date A-Ib approved (19)	NOTES (*Explanations, callback information, instructions, etc.*) (20)
1	KUALA CREEK	Name of head MOHAMMAD ALI Location of unit No. 10	☒ Yes ☐ No	☒ Yes ☐ No	MOHAMMAD ALI	☒ On own account ☐ In partnership ☐ As chieftain or hired manager	6	4	☒ Head ☐ Wife ☐ Other relative ☐ Other (*Specify*)		X		X		12			19/11/71		X
2		Name of head RAHMAN KHAN Location of unit No. 11	☒ Yes ☐ No	☒ Yes ☐ No	RAHMAN KHAN	☐ On own account ☒ In partnership ☐ As chieftain or hired manager	30	75	☒ Head ☐ Wife ☐ Other relative ☐ Other (*Specify*)	X			X	3						X
3		Name of head MOHAMMAD YAKUB Location of unit No. 12	☒ Yes ☐ No	☒ Yes ☐ No	MOHAMMAD YAKUB	☒ On own account ☐ In partnership ☐ As chieftain or hired manager	5	17	☒ Head ☐ Wife ☐ Other relative ☐ Other (*Specify*)		X		X							X
4		Name of head PHAUL RAHMAN Location of unit No. 13	☒ Yes ☐ No	☒ Yes ☐ No	PHAUL RAHMAN	☒ On own account ☐ In partnership ☐ As chieftain or hired manager	27	—	☐ Head ☐ Wife ☒ Other relative ☐ Other (*Specify*)	X			X							X
5		Name of head YUSUF RAHMAN Location of unit No. 14	☒ Yes ☐ No	☒ Yes ☐ No	YUSUF RAHMAN	☒ On own account ☐ In partnership ☐ As chieftain or hired manager	2	—	☒ Head ☐ Wife ☐ Other relative ☐ Other (*Specify*)		X		X		13					X
6		Name of head ASHARF QURESHI Location of unit No. 15	☒ Yes ☐ No	☒ Yes ☐ No	ASHARF QURESHI	☒ On own account ☐ In partnership ☐ As chieftain or hired manager	2	51	☒ Head ☐ Wife ☐ Other relative ☐ Other (*Specify*)		X		X							X
7		Name of head ABDUL ILYAS Location of unit No. 16	☒ Yes ☐ No	☒ Yes ☐ No	ABDUL ILYAS	☒ On own account ☐ In partnership ☐ As chieftain or hired manager	1	119	☐ Head ☒ Wife ☐ Other relative ☐ Other (*Specify*)	X			X	4						X
8		Name of head MARTIN GOMEZ Location of unit No. 17	☒ Yes ☐ No	☒ Yes ☐ No	MARTIN GOMEZ	☐ On own account ☒ In partnership ☐ As chieftain or hired manager	42	206	☐ Head ☒ Wife ☐ Other relative ☐ Other (*Specify*)	X			X							X
9		Name of head CARLO GOMEZ Location of unit No. 18	☒ Yes ☐ No	☒ Yes ☐ No	CARLO GOMEZ	☐ On own account ☒ In partnership ☐ As chieftain or hired manager	42	206	☒ Head ☐ Wife ☐ Other relative ☐ Other (*Specify*)	X			X	5						X
10		Name of head USMAN ALI Location of unit No. 19	☒ Yes ☐ No	☒ Yes ☐ No	USMAN ALI	☒ On own account ☐ In partnership ☐ As chieftain or hired manager	39	—	☐ Head ☐ Wife ☐ Other relative ☒ Other (*Specify*) chief	X			X							X Holder gone to visit friends in another village.
TOTAL ENTRIES (Including wavy-line entries.) ⟶						10	⟶			6	4	—	10							

Exhibit IV-5-6. LISTING BOOK (NORTHERN TERRITORY), FORM A-2b, FOR DAMASCUS CHIEFDOM IN THE NORTHERN TERRITORY--Continued

Page 3

Line No.	Road name or No.	Name of head of household and location or description of housing unit (If female, determine if she is first of several wives; if so, list husband as holder)	Did any member of this household – Grow any crops of any kind—field, garden, or tree crops, etc., at any time during 1971? (If NO in both columns 4 and 5, skip to 10)	Keep any livestock or poultry at any time during 1971?	What is the name of each member of this household who operated (had charge of) an agricultural holding? (Use a separate line for each such member, beginning with column 6; for partners in some household, however, use only one line.)	How did this person operate the holding – on own account, in partnership, as chieftain, or hired manager? (Mark as many as applicable)	How many of the following animals are NOW on this holding – including those on common or public land it owned [by you], [jointly by your tribe or clan], [by your employer] – Cattle and calves of all ages? (If 25 or more, circle the entry)	Sheep and goats of all ages? (If 100 or more, circle the entry)	Respondent	PSU sampling – Enter "X" if entry – Circled in column 8 or 9	NOT circled in column 8 or 9	National Certainty holding (If YES, draw wavy line through columns 11 and 12) YES	NO	A-1b Questionnaire – Preliminary A-1b No. for circled "X" in – Column 11	Column 12	Date basic question-naire completed	Date area measure-ment completed	FOR SUPERVISOR'S USE – Date listing approved	Date A-1b approved	NOTES (Explanations, callback information, instructions, etc.)
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13) YES	NO	(14)	(15)	(16)	(17)	(18)	(19)	(20)
1	KUALA CREEK	Name of head AHMED HAMID Location of unit No. 20	☒ Yes ☐ No	☒ Yes ☐ No	AHMED HAMID & LAZIM HAMID	☐ On own account ☒ In partnership ☐ As chieftain or hired manager	(58)	6	☐ Head ☐ Wife ☐ Other relative ☒ Other (Specify) Neighbor	Ⓧ			X	6				19/11/71		X
2		Name of head ABDULLA HASSAN Location of unit No. 21	☒ Yes ☐ No	☒ Yes ☐ No	ABDULLA HASSAN	☒ On own account ☐ In partnership ☐ As chieftain or hired manager	8	21	☒ Head ☐ Wife ☐ Other relative ☐ Other (Specify)		Ⓧ		X		⑭					X
3		Name of head ABDEL RAHMAN Location of unit No. 22	☒ Yes ☐ No	☒ Yes ☐ No	ABDEL RAHMAN	☒ On own account ☐ In partnership ☐ As chieftain or hired manager	—	4	☒ Head ☐ Wife ☐ Other relative ☐ Other (Specify)		X		X							X Call back tomorrow night. 18/11/71
4		Name of head HILO CORTEZ Location of unit No. 23	☒ Yes ☐ No	☒ Yes ☐ No	HILO CORTEZ	☒ On own account ☐ In partnership ☐ As chieftain or hired manager	—	9	☐ Head ☐ Wife ☒ Other relative ☐ Other (Specify)		Ⓧ		X		15					X Holder gone, information from nephew.
5		Name of head OMAR SULMAN Location of unit No. 24	☐ Yes ☒ No	☒ Yes ☐ No	OMAR SULMAN	☒ On own account ☐ In partnership ☐ As chieftain or hired manager	5	2	☐ Head ☐ Wife ☒ Other relative ☐ Other (Specify)		X		X							X
6		Name of head Location of unit	☐ Yes ☐ No	☐ Yes ☐ No	HABEEB SULMAN	☒ On own account ☐ In partnership ☐ As chieftain or hired manager	4	—	☐ Head ☐ Wife ☐ Other relative ☒ Other (Specify) Holder		Ⓧ		X		16					X
7		Name of head MAHMOUD ELLATIF Location of unit No. 25	☒ Yes ☐ No	☒ Yes ☐ No	MAHMOUD ELLATIF	☒ On own account ☐ In partnership ☐ As chieftain or hired manager	1	6	☒ Head ☐ Wife ☐ Other relative ☐ Other (Specify)		X		X							X
8		Name of head HASHIM KHALIL Location of unit No. 26	☒ Yes ☐ No	☒ Yes ☐ No	HASHIM KHALIL	☒ On own account ☐ In partnership ☐ As chieftain or hired manager	1	5	☒ Head ☐ Wife ☐ Other relative ☐ Other (Specify)		Ⓧ		X		17					X
9		Name of head Location of unit	☐ Yes ☐ No	☐ Yes ☐ No	AHMED KHALIL	☒ On own account ☐ In partnership ☐ As chieftain or hired manager	—	—	☒ Head ☐ Wife ☐ Other relative ☐ Other (Specify)		X		X							X Only has poultry.
10		Name of head OMAR ALI Location of unit No. 27	☒ Yes ☐ No	☒ Yes ☐ No	TANYA ALI	☒ On own account ☐ In partnership ☐ As chieftain or hired manager	—	—	☐ Head ☒ Wife ☐ Other relative ☐ Other (Specify)		Ⓧ		X		⑱					X Only has poultry. Second wife of Omar Ali.
TOTAL ENTRIES (Including wavy-line entries.) →						10	→			1	9	—	10							

Exhibit IV-5-6. LISTING BOOK (NORTHERN TERRITORY), FORM A-2b, FOR DAMASCUS CHIEFDOM IN THE NORTHERN TERRITORY--Continued

Page 4

Line No.	Road name or No.	Name of head of household and location or description of housing unit (If female, determine if she is first of several wives; if so, list husband as holder)	Did any member of this household —		What is the name of each member of this household who operated (had charge of) an agricultural holding? (Use a separate line for each such member, beginning with column 6; for partners in same household, however, use only one line.)	How did this person operate the holding — on own account, in partnership, as chieftain, or hired manager? (Mark as many as applicable)	How many of the following animals are NOW on this holding — including those on common or public land if owned [by you], [jointly by your tribe or clan], [by your employer] —		Respondent	PSU sampling		National Certainty holding (If YES, draw wavy line through columns 11 and 12)		A-Ib Questionnaire				FOR SUPERVISOR'S USE		NOTES (Explanations, callback information, instructions, etc.)
			Grow any crops of any kind—field, garden, or tree crops, etc., at any time during 1971? (If NO in both columns 4 and 5, skip to 10)	Keep any livestock or poultry at any time during 1971?			Cattle and calves of all ages? (If 25 or more, circle the entry)	Sheep and goats of all ages? (If 100 or more, circle the entry)		Enter "X" if entry — Circled in column 8 or 9	NOT circled in column 8 or 9	YES	NO	Preliminary A-Ib No. for circled "X" in — Column 11	Column 12	Date basic question-naire completed	Date area measure-ment completed	Date listing approved	Date A-Ib approved	
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)		(14)	(15)	(16)	(17)	(18)	(19)	(20)
1	KUALA CREEK	Name of head YUSEF ILYAS Location of unit No. 28	☐ Yes ☒ No	☒ Yes ☐ No	YUSEF ILYAS	☐ On own account ☒ In partnership ☐ As chieftain or hired manager	38	187	☒ Head ☐ Wife ☐ Other relative ☐ Other (Specify)	X			X					19/11/71		X Partnership with brother PHAUL ILYAS
2		Name of head PHAUL ILYAS Location of unit No. 29	☒ Yes ☐ No	☒ Yes ☐ No	PHAUL ILYAS	☒ On own account ☒ In partnership ☐ As chieftain or hired manager	4 38	22 187	☒ Head ☐ Wife ☐ Other relative ☐ Other (Specify)	X	X		X X	7						X
3		Name of head JUAN ABEYA Location of unit	☒ Yes ☐ No	☒ Yes ☐ No	JUAN ABEYA	☒ On own account ☐ In partnership ☐ As chieftain or hired manager	—	167	☒ Head ☐ Wife ☐ Other relative ☐ Other (Specify)	X			X							X
4		Name of head ASHARF KHAN Location of unit No. 31	☒ Yes ☐ No	☒ Yes ☐ No	ASHARF KHAN	☒ On own account ☐ In partnership ☐ As chieftain or hired manager	—	17	☐ Head ☐ Wife ☒ Other relative ☐ Other (Specify)		X		X		19					X Daughter gave information
5	KISMET CREEK	Name of head OMAR YAKUB Location of unit No. 32	☐ Yes ☒ No	☒ Yes ☐ No	OMAR YAKUB	☒ On own account ☐ In partnership ☐ As chieftain or hired manager	3	9	☒ Head ☐ Wife ☐ Other relative ☐ Other (Specify)		X		X							X
6		Name of head Location of unit	☐ Yes ☐ No	☐ Yes ☐ No	NOOR YAKUB	☒ On own account ☐ In partnership ☐ As chieftain or hired manager	1	4	☒ Head ☐ Wife ☐ Other relative ☐ Other (Specify)		X		X		20					X
7		Name of head MAHMOUD BUBER Location of unit No. 33	☒ Yes ☐ No	☒ Yes ☐ No	MAHMOUD BUBER	☒ On own account ☐ In partnership ☐ As chieftain or hired manager	1	3	☒ Head ☐ Wife ☐ Other relative ☐ Other (Specify)		X		X							X
8		Name of head OMAR ALI Location of unit No. 34	☒ Yes ☐ No	☒ Yes ☐ No	ZANA ALI	☒ On own account ☐ In partnership ☐ As chieftain or hired manager	6	6	☒ Head ☐ Wife ☐ Other relative ☐ Other (Specify)		X		X		21					X First wife of Omar Ali.
9		Name of head MURTAZA USMAN Location of unit No. 35	☒ Yes ☐ No	☒ Yes ☐ No	MURTAZA USMAN	☒ On own account ☐ In partnership ☐ As chieftain or hired manager	3	15	☒ Head ☐ Wife ☐ Other relative ☐ Other (Specify)		X		X							X
10		Name of head JAMIL QURESHI Location of unit No. 36	☒ Yes ☐ No	☒ Yes ☐ No	JAMIL QURESHI	☒ On own account ☐ In partnership ☐ As chieftain or hired manager	8	106	☒ Head ☐ Wife ☐ Other relative ☐ Other (Specify)	X			X	8						X
TOTAL ENTRIES (Including wavy-line entries.) →						11	→			4	7	—	11							

Exhibit IV-5-6. LISTING BOOK (NORTHERN TERRITORY), FORM A-2b, FOR DAMASCUS CHIEFDOM IN THE NORTHERN TERRITORY--Continued

Page 5

Line No.	Road name or No.	Name of head of household and location or description of housing unit (*If female, determine if she is first of several wives; if so, list husband as holder*)	Did any member of this household – Grow any crops of any kind—field, garden, or tree crops, etc., at any time during 1971? (*If NO in both columns 4 and 5, skip to 10*)	Keep any livestock or poultry at any time during 1971?	What is the name of each member of this household who operated (had charge of) an agricultural holding? (*Use a separate line for each such member, beginning with column 6; for partners in same household, however, use only one line.*)	How did this person operate the holding – on own account, in partnership, as chieftain, or hired manager? (*Mark as many as applicable*)	How many of the following animals are NOW on this holding – including those on common or public land if owned [by you], [jointly by your tribe or clan], [by your employer] – Cattle and calves of all ages? (*If 25 or more, circle the entry*)	Sheep and goats of all ages? (*If 100 or more, circle the entry*)	Respondent	PSU sampling – Enter "X" if entry – Circled in column 8 or 9	NOT circled in column 8 or 9	National Certainty holding (*If YES, draw wavy line through columns 11 and 12*) YES	NO	A-1b Questionnaire – Preliminary A-1b No. for circled "X" in – Column 11	Column 12	Date basic questionnaire completed	Date area measurement completed	FOR SUPERVISOR'S USE – Date listing approved	Date A-1b approved	NOTES (*Explanations, callback information, instructions, etc.*)
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)		(14)	(15)	(16)	(17)	(18)	(19)	(20)
1	KISMET CREEK	Name of head YUSEE CALDIDE Location of unit No. 37	☒ Yes ☐ No	☒ Yes ☐ No	HARIM CALDIDE	☒ On own account ☐ In partnership ☐ As chieftain or hired manager	9	36	☐ Head ☐ Wife ☒ Other relative ☐ Other (*Specify*)		X		X		22			19/1/71		X Son, who is the holder, gave information
2		Name of head ULTAR KHAN Location of unit No. 38	☒ Yes ☐ No	☒ Yes ☐ No	ULTAR KHAN	☒ On own account ☐ In partnership ☐ As chieftain or hired manager	29	78	☒ Head ☐ Wife ☐ Other relative ☐ Other (*Specify*)	X			X							X
3		Name of head SIRVA OMRAN Location of unit No. 39	☒ Yes ☐ No	☒ Yes ☐ No	SIRVA OMRAN	☒ On own account ☐ In partnership ☐ As chieftain or hired manager	47	121	☐ Head ☒ Wife ☐ Other relative ☐ Other (*Specify*)	X			X	9						X
4		Name of head Location of unit	☐ Yes ☐ No	☐ Yes ☐ No		☐ On own account ☐ In partnership ☐ As chieftain or hired manager			☐ Head ☐ Wife ☐ Other relative ☐ Other (*Specify*)											
5		Name of head Location of unit	☐ Yes ☐ No	☐ Yes ☐ No		☐ On own account ☐ In partnership ☐ As chieftain or hired manager			☐ Head ☐ Wife ☐ Other relative ☐ Other (*Specify*)											
6		Name of head Location of unit	☐ Yes ☐ No	☐ Yes ☐ No		☐ On own account ☐ In partnership ☐ As chieftain or hired manager			☐ Head ☐ Wife ☐ Other relative ☐ Other (*Specify*)											
7		Name of head Location of unit	☐ Yes ☐ No	☐ Yes ☐ No		☐ On own account ☐ In partnership ☐ As chieftain or hired manager			☐ Head ☐ Wife ☐ Other relative ☐ Other (*Specify*)											
8		Name of head Location of unit	☐ Yes ☐ No	☐ Yes ☐ No		☐ On own account ☐ In partnership ☐ As chieftain or hired manager			☐ Head ☐ Wife ☐ Other relative ☐ Other (*Specify*)											
9		Name of head Location of unit	☐ Yes ☐ No	☐ Yes ☐ No		☐ On own account ☐ In partnership ☐ As chieftain or hired manager			☐ Head ☐ Wife ☐ Other relative ☐ Other (*Specify*)											
10		Name of head Location of unit	☐ Yes ☐ No	☐ Yes ☐ No		☐ On own account ☐ In partnership ☐ As chieftain or hired manager			☐ Head ☐ Wife ☐ Other relative ☐ Other (*Specify*)											
TOTAL ENTRIES (Including wavy-line entries.) →						3	→			2	1	—	3							

Exhibit IV-5-6. *LISTING BOOK (NORTHERN TERRITORY), FORM A-2b, FOR DAMASCUS CHIEFDOM IN THE NORTHERN TERRITORY--Continued*

SUMMARY OF PAGE TOTALS

Page No.	Total holdings	On each line, sum of columns 11 and 12 must equal column 7		National Certainty holdings	On each line, sum of columns 11 and 12 must equal figure for YES in column 13		On each line, figure for NO in 13 plus figure for YES in 13 must equal column 7
					YES in column 13 and entry in –		
	Column 7	Column 11	Column 12	YES in column 13	Column 11	Column 12	NO in column 13
1	10	5	5	1	1	—	9
2	10	6	4	—	—	—	10
3	10	1	9	—	—	—	10
4	11	4	7	—	—	—	11
5	3	2	1	—	—	—	3
6							
7							
8							
9							
10							
11							
12							
13							
14							
15							
16							
PSU TOTAL	44	18	26	1	1	—	
	Transcribe above totals to line (h) on front cover			*Transcribe above totals to line (i) on front cover*			

NOTES

Exhibit IV-7-1. WORKSHEET: COMPUTATION OF VARIANCES--GROUPED-STRATUM METHOD, FORM A-281

(For use in computing variances for total Provinces, individual Provinces, and districts. The form has been designed to accommodate two characteristics--columns 2 to 4 for the first and columns 5 to 7 for the second. Column 8 provides for variance computations for ratios of the two characteristics)

Form A-281 AGROSTAN (June 1971) MINISTRY OF ECONOMY NATIONAL STATISTICAL OFFICE WORKSHEET COMPUTATION OF VARIANCES **1971 CENSUS OF AGRICULTURE**	Sheet ______ of ______ (a) Province or district — Total sample PSU's (b) First characteristic __________ (c) Second characteristic __________ (d) Posted by - — Date

	First characteristic			Second characteristic			
PSU No. (1)	Sample total (x_1 or x_2) (2)	PSU difference ($x_1 - x_2$) (3)	Square of difference (column 3)^2 (4)	Sample total (x_1 or x_2) (5)	PSU difference ($x_1 - x_2$) (6)	Square of difference (column 6)^2 (7)	Covariance (column 3 x column 6) (8)
Total							
Weight							
Weighted estimates							

INSTRUCTIONS

Variances can be computed separately for the small holdings and the Local Certainty Holdings. The total variance will be the sum of the variances from both sources.

Items B, C--Selected characteristics for which variances are to be computed. Fill columns 2, 3, 4 and 5, 6, 7 respectively for these characteristics.

Columns 2, 5--x_1 is the sample total for the first in a pair of PSU's; x_2 is the sample total for the second in the pair of PSU's which form a stratum. For purposes of computing the variance, use column 2 for the first characteristic and column 6 for the second characteristic.

Columns 3, 4 and 6, 7, 8--Compute as instructed in the column box-heads.

Adjustment: Results on last line of columns 4, 7, and 8 should be adjusted by $\frac{\text{total number of sample PSU's in area}}{\text{number of sample PSU's used to compute variances}}$.

Exhibit IV-10-1. FLOW CHART OF SAMPLING OPERATIONS

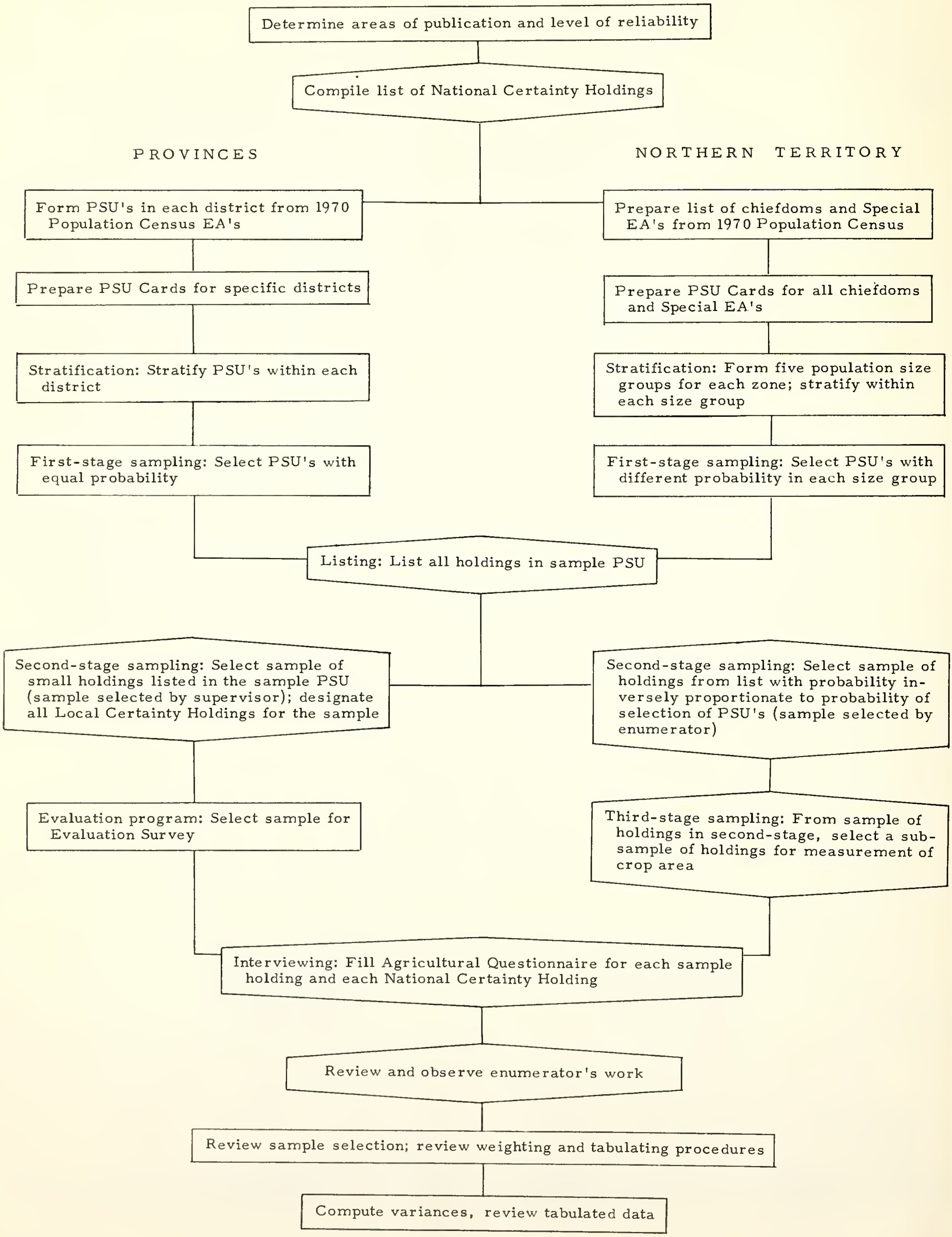
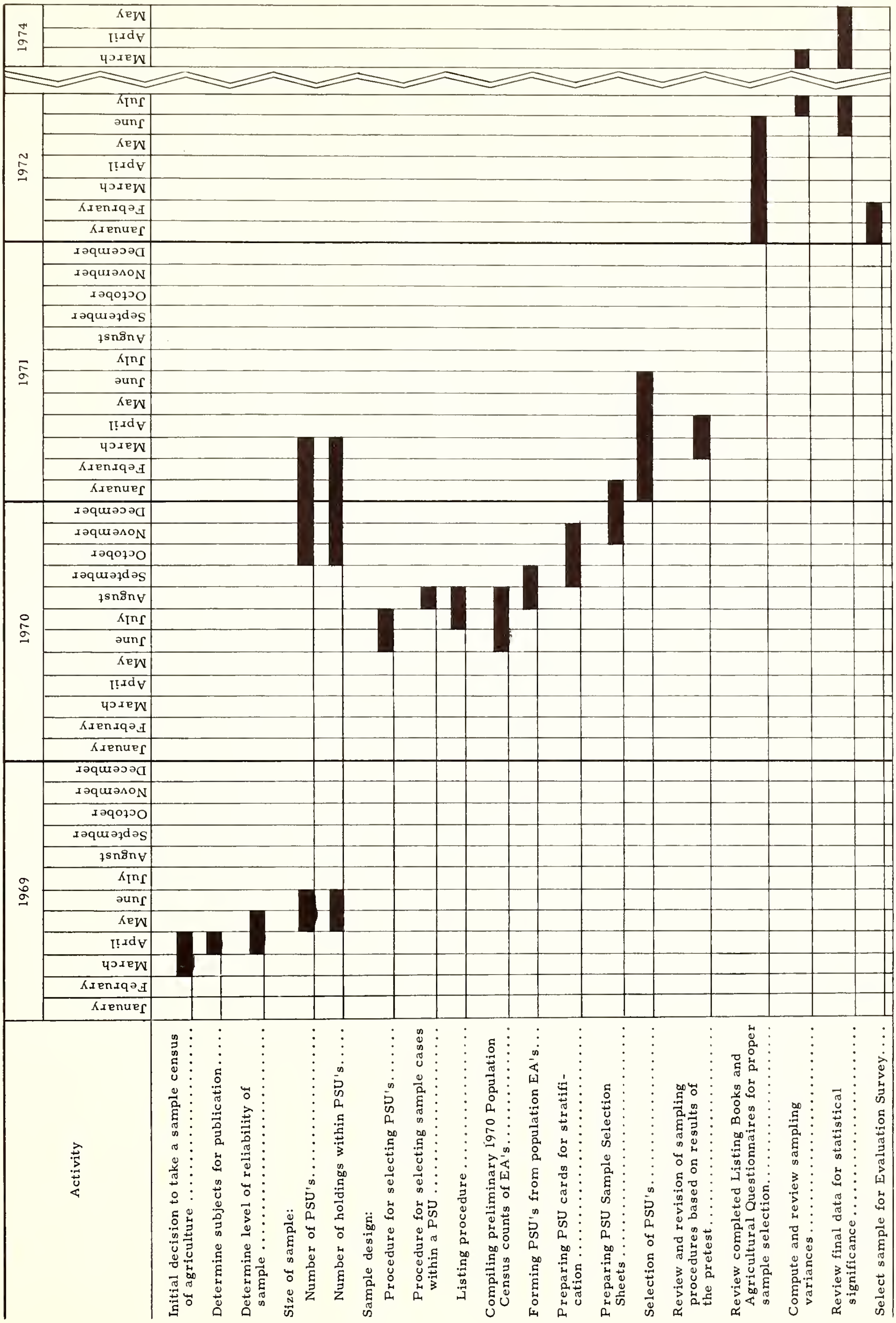

Determine areas of publication and level of reliability
Compile list of National Certainty Holdings
PROVINCES
NORTHERN TERRITORY
Form PSU's in each district from 1970 Population Census EA's
Prepare list of chiefdoms and Special EA's from 1970 Population Census
Prepare PSU Cards for specific districts
Prepare PSU Cards for all chiefdoms and Special EA's
Stratification: Stratify PSU's within each district
Stratification: Form five population size groups for each zone; stratify within each size group
First-stage sampling: Select PSU's with equal probability
First-stage sampling: Select PSU's with different probability in each size group
Listing: List all holdings in sample PSU
Second-stage sampling: Select sample of small holdings listed in the sample PSU (sample selected by supervisor); designate all Local Certainty Holdings for the sample
Second-stage sampling: Select sample of holdings from list with probability inversely proportionate to probability of selection of PSU's (sample selected by enumerator)
Evaluation program: Select sample for Evaluation Survey
Third-stage sampling: From sample of holdings in second-stage, select a subsample of holdings for measurement of crop area
Interviewing: Fill Agricultural Questionnaire for each sample holding and each National Certainty Holding
Review and observe enumerator's work
Review sample selection; review weighting and tabulating procedures
Compute variances, review tabulated data

Exhibit IV-10-2. CALENDAR OF SAMPLING ACTIVITIES

(Applies to Provinces only; for the Northern Territory, timing and content should be adjusted accordingly)



OTHER EXHIBITS FOR REFERENCE

(Exhibits from other units of the case study that are referred to in Unit IV appear on the following pages)

Exhibit I-2-17. MAP LOCATION, AREA, URBAN AND RURAL POPULATION, AND RURAL POPULATION DENSITY, FOR DISTRICTS: 1960

Map location	District (zone)	Area (in km²)	Population, 1960			Rural density
			Total	Urban	Rural	
	BOLIVAR					
F-10	Arcadia	1,369	12,215	3,104	9,111	6.7
G-12	Barcelona	2,828	17,077	4,173	12,904	4.6
F-11	Colorado	1,420	9,819	2,315	7,504	5.3
F-12	Monaco	3,217	23,391	843	22,548	7.0
G-11	Nevada	1,068	15,943	5,740	10,203	9.6
F-11	Orlando	898	25,390	13,765	11,625	12.9
G-11	Palestina	1,601	14,271	943	13,328	8.3
F-10	Quito	1,102	10,187	2,547	7,640	6.9
	DEWAR					
G-9	Angus	3,310	21,421	4,871	16,550	5.0
G-8	Daruel	2,027	14,356	4,096	10,260	5.1
H-8	Daviot	3,009	20,449	4,964	15,485	5.1
G-8	Gleneig	3,842	48,884	2,260	46,624	12.1
F-8	Hamilton	3,924	35,154	1,150	34,004	8.7
G-9	Latheron	3,135	15,506	3,498	12,008	3.8
G-7	Muthill	2,761	25,339	9,597	15,742	5.7
G-8	New Abbey	2,157	17,999	2,361	15,638	7.2
G-7	Pitlochry	3,596	17,644	1,135	16,509	4.6
H-8	Shieldaig	1,884	14,357	3,960	10,397	5.5
G-9	Torridon	3,840	23,079	5,071	18,008	4.7
G-8	Woodside	2,517	12,896	5,380	7,516	3.0
	DUBOIS					
C-7	Aurillac	1,316	139,000	82,256	56,744	43.1
E-9	Bagnois	1,551	24,142	5,290	18,852	12.2
D-7	Cahors	2,419	45,654	10,044	35,610	14.7
E-9	Drome	1,872	21,225	8,444	12,781	6.8
D-7	Fontainbleau	1,480	36,908	6,118	30,790	20.8
E-8	Gannat	2,720	24,306	2,807	21,499	7.9
D-8	Gourdon	4,187	38,196	2,344	35,852	8.6
D-7	Morillon	1,453	51,723	19,763	31,960	22.0
E-8	Pontalier	3,234	23,098	2,327	20,771	6.4
E-9	Riberac	1,508	31,363	6,557	24,806	16.4
D-8	Rochefort	2,689	24,720	2,468	22,252	8.3
D-8	Sancerre	2,294	28,973	2,104	26,869	11.7
C-8	Tarn	1,590	33,846	8,705	25,141	15.8
E-9	Wassy	1,730	26,143	3,142	23,001	13.3
	HASSAM					
B-10	Burdur	1,668	13,902	2,783	11,119	6.7
C-9	El Feser	1,834	53,850	30,943	22,907	12.5
D-8	Gandor	2,283	24,008	14,427	9,581	4.2
C-9	Giza	2,184	88,491	45,627	42,864	19.6
C-8	Hama	2,579	37,044	2,165	34,879	13.5
C-9	Kharga	3,515	33,252	1,268	31,984	9.1
C-9	Mersin	3,542	37,292	10,527	26,765	7.6
C-9	Saghbub	2,283	14,924	3,603	11,321	5.0
D-9	Shendi	1,490	15,582	2,337	13,245	8.9
	LIBERTO					
F-6	Atessa	1,334	65,434	8,220	57,214	42.9
E-7	Cocina	1,501	61,713	6,344	55,369	36.9
E-6	Fermo	1,509	69,532	2,962	66,570	44.1
E-5	Larino	2,848	24,386	3,540	20,846	7.3
E-6	Lucra	1,477	194,200	100,207	93,993	63.6
F-7	Nicastro	3,440	72,612	10,357	62,255	18.1
E-6	Osimo	2,756	69,481	3,078	66,403	24.1
F-6	Pergola	2,895	43,953	2,700	41,253	14.2
E-6	San Giovanni	1,442	106,119	45,138	60,981	42.3
	LIBERTO—Con.					
E-6	Semara	2,398	85,889	12,184	73,705	30.7
F-5	Sesto	3,501	21,856	3,158	18,698	5.3
F-6	Venessa	1,490	45,351	2,225	43,126	28.9
	LOPEZ					
E-7	Arizona	1,490	62,823	7,469	55,354	37.2
E-7	Aurora	1,620	29,812	6,603	23,209	14.3
E-9	Betances	3,677	43,728	5,672	38,056	10.3
E-8	Bilbao	3,686	63,097	4,395	58,702	15.9
E-7	Calicut	159	375,183	375,183	(X)	(X)
E-8	Caribar	3,720	46,942	6,206	40,736	11.0
F-8	Constitucion	2,019	42,219	6,555	35,664	17.7
E-7	Daytona	1,626	50,382	8,608	41,774	25.7
F-8	Elba	1,060	19,517	4,581	14,936	14.1
F-8	Emela	3,537	39,515	1,326	38,189	10.8
F-7	Fontana	2,418	40,701	2,567	38,134	15.8
F-7	Galatea	3,076	99,384	5,824	93,560	30.4
E-7	Murcia	3,574	96,428	7,071	89,357	25.0
F-7	Ontario	3,243	46,582	1,544	45,038	13.9
E-7	Pasadina	1,237	56,075	5,379	50,696	41.0
F-8	Rulinda	3,622	40,693	2,161	38,532	10.6
E-7	Salome	1,665	163,419	24,845	138,574	83.2
E-7	Santa Ana	1,355	326,712	144,469	182,243	134.5
F-8	Sorento	1,938	31,808	2,576	29,232	15.1
F-7	Teruel	1,512	31,588	3,557	28,031	18.5
	LO-SAN-THO					
G-10	Bangor	2,970	24,015	5,312	18,703	6.3
F-10	Cochabamba	2,084	18,607	3,290	15,317	7.4
F-10	Denizli	1,688	11,705	625	11,080	6.6
G-10	Halab	1,276	19,649	6,138	13,511	10.6
G-9	Jumba	2,861	33,529	8,231	25,298	8.8
F-9	Kabul	2,108	20,089	4,578	15,511	7.4
F-10	Larkana	2,701	21,639	418	21,221	7.9
F-9	Managua	3,301	42,454	7,034	35,420	10.7
F-9	Nigeria	2,793	24,451	2,230	22,221	8.0
G-10	Ream	1,785	18,307	4,007	14,300	8.0
G-10	Sumba	1,853	21,667	5,164	16,503	8.9
	MORGAN					
C-7	Aspatria	3,785	93,120	12,776	80,344	21.2
D-7	Bowes	3,291	83,685	6,427	77,258	23.5
D-6	Carnforth	3,665	75,609	12,312	63,297	17.3
D-7	Edmunds	1,592	43,722	8,143	35,579	22.3
D-6	Glemford	1,280	29,192	3,645	25,547	20.0
C-7	Greenwich	1,813	40,376	1,360	39,016	21.5
C-6	Hindon	2,366	24,613	2,974	21,639	9.1
D-6	Kidderminster	4,372	16,846	1,582	15,264	3.5
C-7	Louth	6,496	11,761	3,114	8,647	1.3
D-6	Matlocks	4,888	39,186	4,715	34,471	7.1
C-6	Shattesbury	2,287	9,510	2,416	7,094	3.1
C-6	Thirsk	1,832	131,934	64,734	67,200	36.7
	PARIS					
H-10	Alencon	1,523	7,737	739	6,998	4.6
G-12	Barbados	2,046	7,901	422	7,479	3.7
H-10	Bourges	3,584	31,200	1,154	30,046	8.4
H-10	Chalet	1,707	7,425	648	6,777	4.0
H-11	Chateau	861	10,464	2,175	8,289	9.6
G-11	Damasco	2,485	23,026	1,169	21,857	8.8
G-11	Felletin	1,614	12,243	579	11,664	7.2

Exhibit I-2-17. MAP LOCATION, AREA, URBAN AND RURAL POPULATION, AND RURAL POPULATION DENSITY, FOR DISTRICTS: 1960--Continued

Map location	District (zone)	Area (in km^2)	Population, 1960			Rural density
			Total	Urban	Rural	
	PARIS—Con.					
G-11	Gisors..........	886	17,930	5,192	12,738	14.4
G-11	Grecia..........	1,819	13,980	503	13,477	7.4
G-12	La Grand Combe..	1,001	4,524	832	3,692	3.7
G-11	Moutier.........	1,200	10,805	1,261	9,544	8.0
H-10	Nyons...........	2,031	12,186	488	11,698	5.8
H-11	Prades..........	1,394	10,588	1,147	9,441	6.8
G-10	Sao Paulo.......	1,586	19,227	4,327	14,900	9.4
G-12	Tarbes..........	1,907	16,783	2,011	14,772	7.7
G-11	Troy............	1,535	15,451	1,248	14,203	9.3
G-10	Vallon..........	2,742	20,731	512	20,219	7.4
G-10	Vaucluse........	1,810	17,441	607	16,834	9.3
	RAJPUR					
D-10	Adoni...........	3,466	21,452	4,022	17,430	5.0
C-10	Ajmer...........	2,134	86,170	51,298	34,872	16.3
D-9	Baroda..........	3,711	39,926	6,165	33,761	9.1
D-11	Bellary.........	3,198	21,966	3,446	18,520	5.8
F-10	Bhopal..........	3,521	25,713	1,150	24,563	7.0
D-9	Chanda..........	3,276	40,021	2,147	37,874	11.6
D-10	Chirmuri........	3,668	40,294	1,631	38,663	10.5
D-11	Dabhor..........	4,204	9,398	723	8,675	2.1
E-11	Jaipur..........	3,246	8,672	468	8,204	2.5
D-11	Kanpur..........	3,718	25,815	2,297	23,518	6.3
E-10	Karur...........	3,956	28,912	2,146	26,766	6.8
E-10	Kistna..........	3,258	12,914	883	12,031	3.7
D-10	Kolar...........	2,402	28,501	428	28,073	11.7
D-11	Poona...........	5,577	20,624	771	19,853	3.6
D-10	Ranchi..........	3,381	34,669	3,177	31,492	9.3
E-10	Warangol........	3,667	55,833	11,036	44,797	12.2
	RAMA					
H-9	Bogra...........	1,471	24,512	7,269	17,243	11.7
I-9	Bundi...........	2,064	17,810	6,332	11,478	5.6
H-8	Colombia........	1,635	28,893	9,371	19,522	11.9
H-8	Davengere.......	1,743	22,191	6,425	15,766	9.0
I-8	Karania.........	2,306	18,734	5,449	13,285	5.8
H-9	Malega..........	2,512	16,847	5,979	10,868	4.3
H-9	Nagina..........	2,108	11,573	2,728	8,845	4.2
H-9	Patan...........	3,568	16,456	611	15,845	4.4
H-10	Rangpur.........	2,286	18,611	2,853	15,758	6.9
H-8	Sirsa...........	2,065	21,625	3,617	18,008	8.7
H-9	Surat...........	2,964	27,864	2,040	25,824	8.7
H-8	Tuni............	1,081	19,207	6,492	12,715	11.8
H-8	Vellore.......	1,539	22,596	1,922	20,674	13.4
H-8	Victoria......	1,110	28,926	6,511	22,415	20.2
I-9	Wadi..........	3,055	8,853	563	8,290	2.7
	TALI					
B-7	Acapulco......	3,447	57,345	5,239	52,106	15.1
C-8	Athens........	3,562	116,108	10,447	105,661	29.7
B-9	Baghdad.......	2,244	48,673	5,450	43,223	19.3
C-7	Chicago.......	1,635	30,402	2,978	27,424	16.8
B-8	Congo.........	1,354	57,094	11,266	45,828	33.8
B-7	Delhi.........	2,335	36,998	2,118	34,880	14.9
C-7	Ghana.........	3,289	54,177	2,667	51,510	15.7
A-8	Greenland.....	3,960	66,436	3,887	62,549	15.8
B-8	Istanbul......	1,918	48,785	2,847	45,938	24.0
C-8	Karachi.......	1,450	50,844	6,674	44,170	30.5
C-8	La Paz........	2,970	49,451	2,163	47,288	15.9
B-7	Manila........	1,378	69,999	22,315	47,684	34.6
B-8	Nikki.........	2,014	37,526	3,448	34,078	16.9
B-8	Sokoto........	842	276,854	173,113	103,741	123.2
C-8	Wankie........	3,926	81,240	5,102	76,138	19.4
	VALENCIA					
G-7	Alberta.......	1,516	26,075	8,430	17,645	11.6
G-6	Aragon........	4,227	18,353	3,927	14,426	3.4
H-7	Costa Brava...	3,649	23,003	2,874	20,129	5.5
G-6	El Dorado.....	4,493	15,718	2,222	13,496	3.0
G-7	Las Cruces....	2,401	22,868	4,971	17,897	7.5
F-6	Logrono.......	3,816	21,798	3,515	18,283	4.8
F-7	Monte Carlo...	2,549	32,721	2,736	29,985	11.8
G-6	Niza..........	3,503	43,579	12,546	31,033	8.9
G-7	Pasto.........	2,802	34,857	3,636	31,221	11.1
H-7	Puntarenas....	2,283	15,281	3,148	12,133	5.3
	NORTHERN TERRITORY*					
E-12	Atbara River Basin........	38,552	130,000	23,500	106,500	2.8
D-13	Northwest.....	33,261	95,000	2,700	92,300	2.8
E-13	Subic Mountains....	22,926	75,000	1,100	73,900	3.2

*Estimated.
(X) Not applicable.

Source: 1960 Census of Population for the Provinces.

Exhibit I-2-21. NUMBER OF AGRICULTURAL HOLDINGS BY SIZE OF HOLDING, BY PROVINCES: 1961

(Excludes Northern Territory. Number of holdings rounded to nearest hundred)

Size of holding (hectares)	Provinces			Bolivar			Dewar			DuBois			Hassam			Liberto			Lopez		
	Number of holdings	Percent		Number of holdings	Percent		Number of holdings	Percent		Number of holdings	Percent		Number of holdings	Percent		Number of holdings	Percent		Number of holdings	Percent	
		Distri-bution	Cumu-lative		Distri-bution	Cumu-lative		Distri-bution	Cumu-lative		Distri-bution	Cumu-lative		Distri-bution	Cumu-lative		Distri-bution	Cumu-lative		Distri-bution	Cumu-lative
Total.......	806,400	100.0	-	14,200	100.0	-	29,200	100.0	-	57,000	100.0	-	24,600	100.0	-	107,800	100.0	-	181,200	100.0	-
0.5 to 0.9......	68,100	8.4	8.4	500	3.2	3.2	1,700	5.7	5.7	5,200	9.1	9.1	1,500	6.2	6.2	13,400	12.4	12.4	17,900	9.9	9.9
1.0 to 1.9......	90,700	11.3	19.7	1,000	7.0	10.2	1,900	6.5	12.2	5,400	9.5	18.6	1,400	5.6	11.8	14,800	13.6	26.1	31,300	17.3	27.2
2.0 to 2.9......	89,200	11.0	30.7	1,000	7.1	17.3	2,200	7.6	19.8	6,000	10.6	29.2	1,400	5.7	17.5	14,800	13.8	39.9	27,500	15.1	42.3
3.0 to 3.9......	94,000	11.7	42.4	1,600	11.3	28.6	2,400	8.1	27.9	7,700	13.4	42.6	1,900	7.8	25.3	13,200	11.2	52.1	25,500	14.1	56.4
4.0 to 4.9......	91,500	11.3	53.7	2,000	13.7	42.3	2,900	9.9	37.8	6,500	11.4	54.0	2,100	8.6	33.9	15,800	14.6	66.7	18,800	10.4	66.8
5.0 to 9.9......	156,300	19.4	73.1	3,200	22.5	64.8	6,000	20.6	58.4	12,100	21.2	75.2	2,800	11.3	45.2	24,500	22.7	89.4	29,300	16.1	82.9
10.0 to 19.9....	106,700	13.3	86.4	2,500	17.7	82.5	3,800	13.2	71.6	6,600	11.6	86.8	4,300	17.5	62.7	7,300	6.8	96.2	21,700	12.0	94.9
20.0 to 49.9....	56,000	6.9	93.3	1,000	7.1	89.6	2,000	6.9	78.5	4,300	7.5	94.3	6,300	25.8	88.5	2,500	2.3	98.5	6,400	3.5	98.4
50.0 to 99.9....	20,500	2.5	95.8	600	4.3	93.9	1,700	5.9	84.4	1,500	2.5	96.8	1,600	6.6	95.1	700	0.7	99.2	500	0.3	98.7
100.0 to 199.9..	19,100	2.4	98.2	300	2.2	96.1	2,900	9.7	94.1	1,000	1.8	98.6	600	2.4	97.5	600	0.5	99.7	1,000	0.5	99.2
200.0 to 499.9..	10,800	1.4	99.6	400	3.1	99.2	1,700	5.7	99.8	400	0.7	99.3	400	1.6	99.1	200	0.2	99.9	400	0.2	99.4
500.0 or more...	3,600	0.4	100.0	100	0.8	100.0	100	0.2	100.0	400	0.7	100.0	200	0.9	100.0	200	0.2	100.0	1,000	0.6	100.0

Size of holding (hectares)	Lo-San-Tho			Morgan			Paris			Rajpur			Rama			Tali			Valencia		
	Number of holdings	Percent		Number of holdings	Percent		Number of holdings	Percent		Number of holdings	Percent		Number of holdings	Percent		Number of holdings	Percent		Number of holdings	Percent	
		Distri-bution	Cumu-lative		Distri-bution	Cumu-lative		Distri-bution	Cumu-lative		Distri-bution	Cumu-lative		Distri-bution	Cumu-lative		Distri-bution	Cumu-lative		Distri-bution	Cumu-lative
Total.......	31,300	100.0	-	73,900	100.0	-	33,700	100.0	-	60,100	100.0	-	32,600	100.0	-	136,500	100.0	-	24,100	100.0	-
0.5 to 0.9......	1,000	3.1	3.1	6,500	8.7	8.7	900	2.7	2.7	2,000	3.4	3.4	1,800	5.4	5.4	15,000	11.0	11.0	900	3.8	3.8
1.0 to 1.9......	2,500	8.2	11.3	8,300	11.3	20.0	1,500	4.4	7.1	3,800	6.4	9.8	1,500	4.6	10.0	16,500	12.0	23.0	700	2.8	6.6
2.0 to 2.9......	3,500	11.1	22.4	8,200	11.1	31.1	2,900	8.5	15.6	3,600	6.0	15.8	1,200	3.7	13.7	15,200	11.2	34.2	1,700	7.2	13.8
3.0 to 3.9......	3,200	10.2	32.6	8,600	11.7	42.8	3,000	8.8	24.4	6,800	11.2	27.0	1,100	3.4	17.1	16,800	12.2	46.4	2,300	9.6	23.4
4.0 to 4.9......	3,600	11.4	44.0	8,700	11.8	54.6	3,800	11.4	35.8	5,800	9.6	36.6	1,400	4.2	21.3	18,000	13.2	59.6	2,200	9.2	32.6
5.0 to 9.9......	6,100	19.4	63.4	16,500	22.3	76.9	7,700	22.7	58.5	11,400	18.9	55.5	6,300	19.2	40.5	26,300	19.3	78.9	4,200	17.4	50.0
10.0 to 19.9....	4,200	13.3	76.7	11,600	15.7	92.6	5,300	15.6	74.1	7,900	13.2	68.7	8,800	26.9	67.4	19,300	14.1	93.0	3,400	14.1	64.1
20.0 to 49.9....	2,200	7.0	83.7	3,200	4.3	96.9	4,800	14.1	88.2	9,700	16.0	84.7	4,600	14.1	81.5	6,500	4.8	97.8	2,700	11.1	75.2
50.0 to 99.9....	2,700	8.7	92.4	900	1.2	98.1	2,300	6.9	95.1	2,400	4.0	88.7	2,400	3.2	88.7	900	0.7	98.5	2,200	9.2	84.4
100.0 to 199.9..	1,700	5.6	98.0	800	1.0	99.1	1,200	3.5	98.6	3,700	6.2	94.9	2,200	6.7	95.4	900	0.6	99.1	2,400	9.8	94.2
200.0 to 499.9..	400	1.3	99.3	500	0.7	99.8	300	0.8	99.4	2,700	4.4	99.3	1,400	4.3	99.7	900	0.6	99.7	1,200	5.1	99.3
500.0 or more...	200	0.7	100.0	200	0.2	100.0	200	0.6	100.0	400	0.7	100.0	100	0.3	100.0	300	0.3	100.0	200	0.7	100.0

- Entry represents zero.

Source: 1961 Sample Census of Agriculture for the Provinces.

Exhibit I-2-34. POPULATION BY AGE AND SEX, URBAN AND RURAL: 1960

(Excludes Northern Territory)

Age (years)	Total			Urban			Rural		
	Total (000)	Male (000)	Female (000)	Total (000)	Male (000)	Female (000)	Total (000)	Male (000)	Female (000)
NUMBER									
Total	7,087	3,459	3,629	1,848	983	865	5,239	2,475	2,764
Under 1 year	262	131	131	74	37	37	188	94	94
1 to 4 years	928	467	462	275	132	144	653	335	318
5 to 9 years	971	491	480	268	120	148	703	371	332
10 to 14 years	737	370	367	189	92	96	549	278	271
15 to 19 years	659	329	331	177	94	83	482	234	248
20 to 24 years	567	277	290	203	108	95	364	169	195
25 to 34 years	964	470	493	288	190	99	676	281	395
35 to 44 years	780	384	396	179	105	74	600	279	322
45 to 54 years	553	259	293	98	56	42	455	203	251
55 to 64 years	354	156	199	50	27	23	304	129	175
65 to 74 years	213	90	123	26	13	13	187	77	110
75 years and over	99	35	65	20	9	11	79	26	53
PERCENT									
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Under 1 year	3.7	3.8	3.6	4.0	3.8	4.2	3.6	3.8	3.4
1 to 4 years	13.1	13.5	12.7	14.9	13.4	16.6	12.5	13.5	11.5
5 to 9 years	13.7	14.2	13.2	14.5	12.2	17.1	13.4	15.0	12.0
10 to 14 years	10.4	10.7	10.1	10.2	9.4	11.1	10.5	11.2	9.8
15 to 19 years	9.3	9.5	9.1	9.6	9.6	9.6	9.2	9.5	9.0
20 to 24 years	8.0	8.0	8.0	11.0	11.0	11.0	6.9	6.8	7.1
25 to 34 years	13.6	13.6	13.6	15.6	19.3	11.4	12.9	11.3	14.3
35 to 44 years	11.0	11.1	10.9	9.7	10.7	8.6	11.5	11.3	11.6
45 to 54 years	7.8	7.5	8.1	5.3	5.7	4.8	8.7	8.2	9.1
55 to 64 years	5.0	4.5	5.5	2.7	2.7	2.7	5.8	5.2	6.3
65 to 74 years	3.0	2.6	3.4	1.4	1.3	1.5	3.5	3.1	4.0
75 years and over	1.4	1.0	1.8	1.1	0.9	1.3	1.5	1.0	1.9

Source: 1960 Census of Population for the Provinces.

Exhibit I-2-35. NUMBER OF PERSONS IN THE HOUSEHOLD, URBAN AND RURAL: 1960

(Excludes Northern Territory)

Number of persons	Total		Urban		Rural	
	Number (000)	Percent	Number (000)	Percent	Number (000)	Percent
All households[1]	1,346	100.0	393	100.0	953	100.0
1 person	60	4.5	32	8.1	28	2.9
2 persons	139	10.3	50	12.7	89	9.3
3 persons	176	13.1	56	14.2	120	12.6
4 persons	197	14.6	59	15.0	138	14.5
5 persons	211	15.7	58	14.7	153	16.1
6 persons	174	12.9	49	12.5	125	13.1
7 persons	139	10.3	36	9.2	103	10.8
8 persons	84	6.2	21	5.3	63	6.6
9 persons	70	5.2	15	3.8	55	5.8
10 or more	96	7.1	17	4.3	79	8.3
Median	5.0	(X)	4.5	(X)	5.2	(X)

(X) Not applicable.

[1] By definition, a household consists of all the persons who occupy a housing unit; the count of households, therefore, is equal to the count of occupied housing units.

Source: 1960 Census of Population for the Provinces.

Exhibit II-2-1. CALENDAR OF MAJOR CENSUS ACTIVITIES

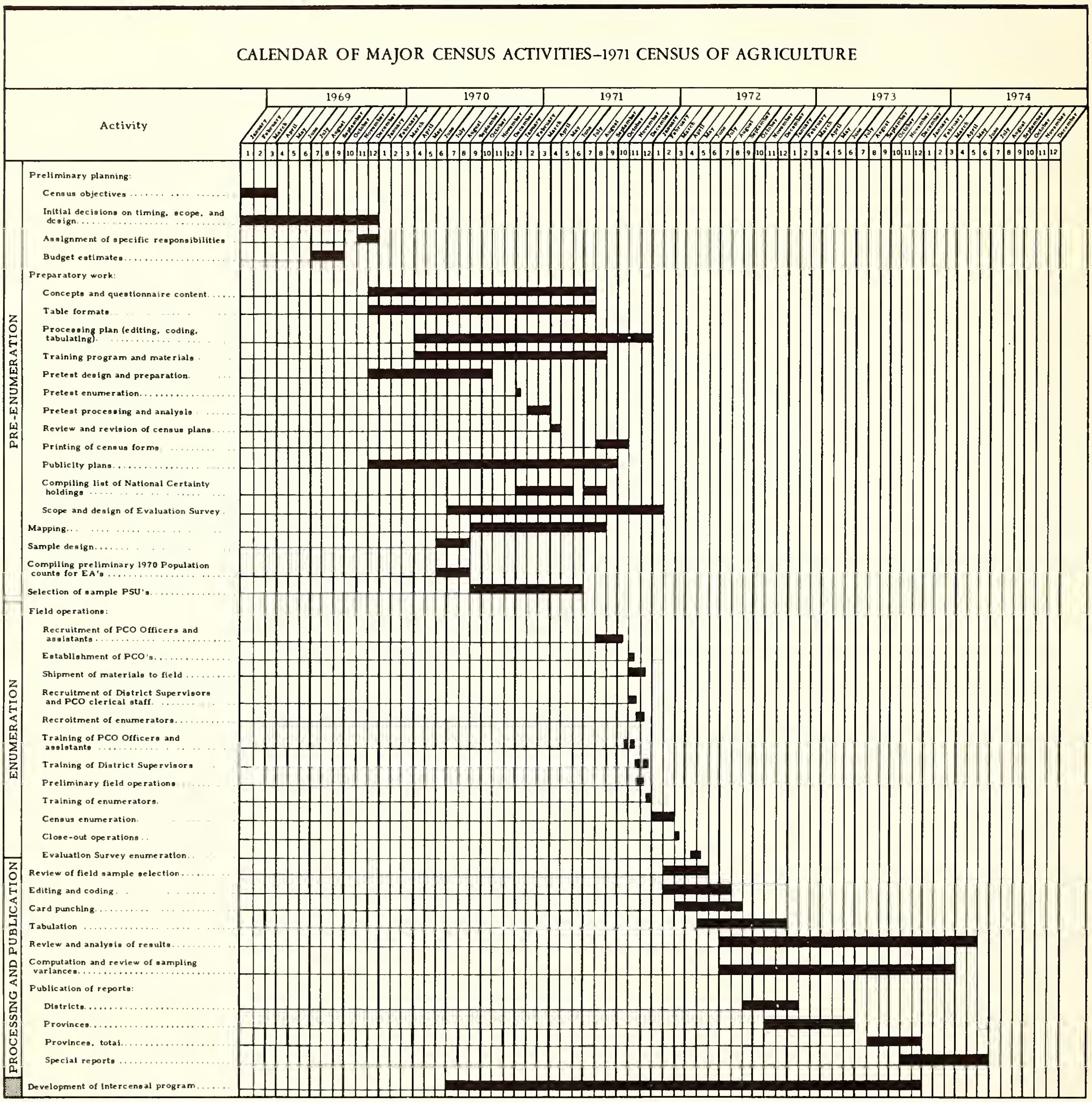
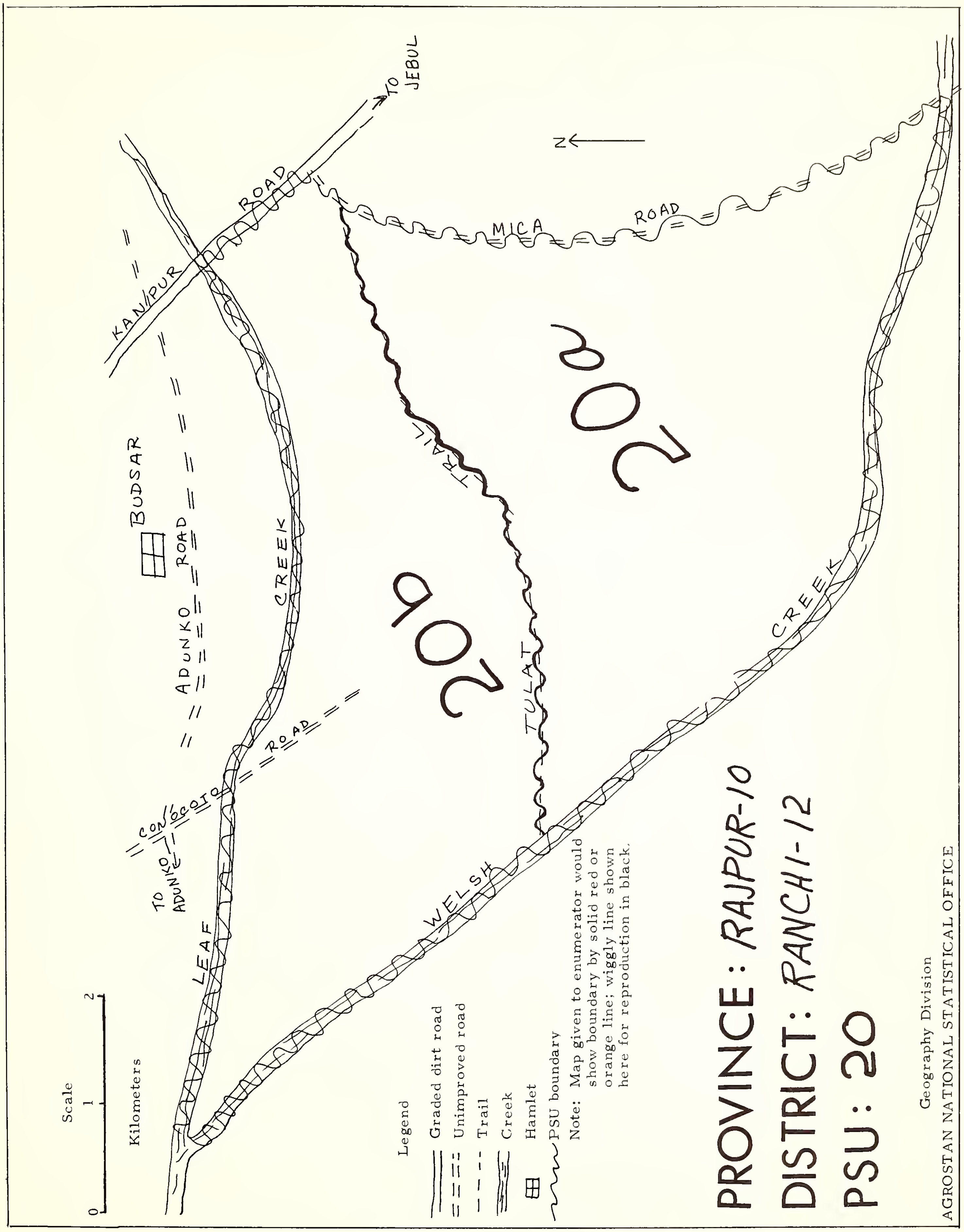


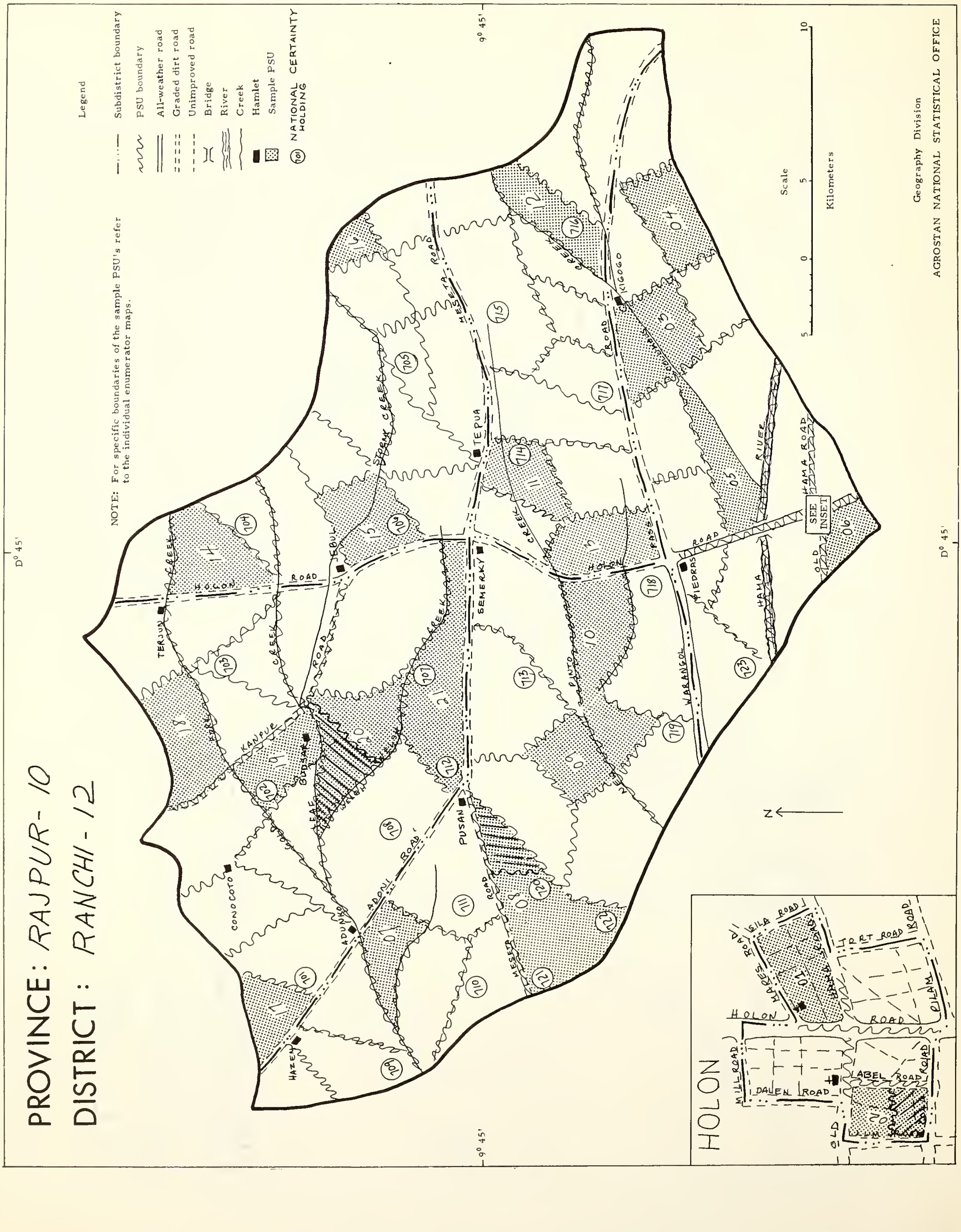
Exhibit II-3-4. EXAMPLE OF A SUBDIVIDED SAMPLE PSU



Note: Map given to enumerator would show boundary by solid red or orange line; wiggly line shown here for reproduction in black.

Exhibit II-3-6. ***DISTRICT MAP SHOWING SAMPLE PSU'S AND LOCATION OF NATIONAL CERTAINTY HOLDINGS***

(PSU's that were subdivided are those with cross-hatching on the portion not to be enumerated)



NOTE: For specific boundaries of the sample PSU's refer to the individual enumerator maps.

Exhibit III-2-3. 1971 CENSUS OF AGRICULTURE QUESTIONNAIRE (NORTHERN TERRITORY), FORM A-1b

Form A-1b (AGROSTAN)
(March 1971)
MINISTRY OF ECONOMY
NATIONAL STATISTICAL OFFICE

1971 CENSUS OF AGRICULTURE QUESTIONNAIRE
(Northern Territory)

IDENTIFICATION

A. Name of holder				B. Listing Book (A-2b) →	Page	Line	C. Preliminary A-1b No.
D. Zone	Code	E. District	Code	F. PSU No.	FOR OFFICE USE G. Final A-1b No.	H. Sampling weight

ENUMERATOR: If the respondent is someone other than the holder, be sure he understands that the terms "you" and "your" refer to the holder.

Section I – METHOD OF OPERATION AND TENURE

1. Method of operation

1 ☐ On own account
2 ☐ In partnership *(Skip to 3)*
3 ☐ As chieftain *(Skip to 4)*
4 ☐ As hired manager *(Skip to 5)*

FOR OFFICE USE	
Tenure	
Irrigation	
Livestock and/or poultry	
Type	
Size	
Card No.	

2. *(If operated "on own account")* **This questionnaire concerns the holding you operated on your own account. Include all land on which you grew crops or kept livestock at any time this year, 1971. Do not consider public or communal grazing land as part of this holding.**

Of the land in this holding, was any –

	Yes	No
(1) Assigned to you by your tribe or clan?	1 ☐	2 ☐
(2) Owned by you?	1 ☐	2 ☐
(3) Rented FROM others for cash or a share of the production?	1 ☐	2 ☐
(4) Used on a squatter basis?	1 ☐	2 ☐
(5) Used on some other basis?	1 ☐	2 ☐

(Specify) ________________

(Skip to Section II) 4

3. *(If operated "in partnership")* **This questionnaire concerns the holding you operated in partnership with others at any time this year, 1971.**

a. **Who is the principal partner?** *(If partners are of equal rank, consider the older (oldest) as the principal partner.)*

☐ Holder named in item A of the Identification Section *(Skip to 3c)*
☐ Other person – Name ________ *(Surname)* ________ *(Given name)*

b. Name of other person

☐ Appears in Listing Book → Page ____, Line ____ } *(Skip to Section XII)*
☐ Does not appear in Listing Book

c. **Include all land on which you and your partner(s) grew crops or kept livestock at any time this year. Do not consider public or communal grazing land as part of the holding.**

Of the land in this holding, was any –

	Yes	No
(1) Assigned to you by your tribe or clan?	1 ☐	2 ☐
(2) Owned by you?	1 ☐	2 ☐
(3) Rented FROM others for cash or a share of the production?	1 ☐	2 ☐
(4) Used on a squatter basis?	1 ☐	2 ☐
(5) Used on some other basis?	1 ☐	2 ☐

(Specify) ________________

(Skip to Section II) 4

4. *(If operated "as chieftain")* **At any time this year, 1971, did you operate or supervise –**

	Yes	No
a. Any land on which the crops were owned jointly by your tribe or clan?	1 ☐	2 ☐
b. Any grazing land on which the livestock was owned jointly by the tribe or clan?	1 ☐	2 ☐

(If "No" to both 4a and 4b, Skip to Section XII) 4

(If "Yes" in either 4a or 4b) – **This questionnaire concerns the holding which you operated or supervised as a chieftain. Do not consider land assigned to individual members of your tribe as part of this holding.** *(Skip to Section II)*

5. *(If operated "as hired manager")* **This questionnaire concerns the holding you operated as a hired manager, this year, 1971.**

a. **What is your employer's name?** ________ *(Name of person or agency)*

b. **Is your employer –**

1 ☐ A private person?
2 ☐ A corporation?
3 ☐ A cooperative?
4 ☐ A government agency?
☐ Other *(Specify)* ________

c. **What is the mailing address of your employer?**

________ *(Zone)* ________ *(District)* ________ *(Hamlet or chiefdom)*

d. **The holding you manage for others includes all land on which you grew crops or kept livestock for your employer. Do not consider public or communal grazing land as part of this holding.**

Of the land in this holding, did your employer –

	Yes	No
(1) Own any?	1 ☐	2 ☐
(2) Rent any FROM others for cash or a share of the production?	1 ☐	2 ☐
(3) Use any on a squatter basis?	1 ☐	2 ☐
(4) Use any on some other basis?	1 ☐	2 ☐

(Specify) ________________ 4

Section II – TEMPORARY CROPS HARVESTED THIS YEAR, 1971

This section concerns all temporary crops harvested this year, 1971. These are crops generally planted each year or grown in rotation. Report crops for this holding only.

CEREALS FOR GRAIN 2

Were any of the following cereals harvested for GRAIN –

	Yes
6. Wheat?	6 ☐
7. Rice – paddy (irrigated)?	7 ☐
8. Rice – upland?	8 ☐
9. Sorghum?	9 ☐
10. Maize (corn)?	10 ☐
11. Barley?	11 ☐
13. Other cereals for grain – millet, oats, rye, etc.?	13 ☐

(Specify) ________________

☐ None *(NO for 6 through 13)*

LEGUMES FOR GRAIN

Were any of the following legumes harvested mainly for GRAIN –

	Yes
14. Edible dry beans – excluding broad beans *(see 16)* and soybeans *(see 27)*?	14 ☐
15. Edible dry peas – excluding chick peas, cowpeas, and pigeon peas *(see 16)*?	15 ☐
16. Other legumes for grain – broad beans, chick peas, cowpeas, pigeon peas, lentils, etc.?	16 ☐

(Specify) ________________

☐ None *(NO for 14 through 16)*

TUBER, ROOT, BULB CROPS

Were any of the following tuber, root, or bulb crops harvested FOR FOOD OR FOR LIVESTOCK OR POULTRY FEED –

	Yes
17. Potatoes, Irish or white – early and late crops for all purposes including seed?	17 ☐
18. Manioc (cassava)?	18 ☐
19. Sweet potatoes or yams?	19 ☐
20. Dry onions?	20 ☐
21. Other tuber, root, or bulb crops grown FOR FEED – turnips, sugar beets, etc.?	21 ☐

(Specify) ________________
(If for food, report in 34 or 43)

☐ None *(NO for 17 through 21)*

CROPS FOR INDUSTRIAL USE

Were any of the following temporary crops harvested mainly for INDUSTRIAL USE –

	Yes
22. Sugarcane cut for sugar or syrup or for sale to mills?	22 ☐
23. Sugarcane cut for other purposes except for feed or thatching?	23 ☐
24. Cotton?	24 ☐
25. Groundnuts (peanuts)?	25 ☐
26. Tobacco?	26 ☐
27. Soybeans?	27 ☐
28. Other temporary crops mainly for industrial use – castor beans, sesame, etc.?	28 ☐

(Specify) ________________

☐ None *(NO for 22 through 28)*

FODDER CROPS

Were any of the following fodder crops harvested from land in crop rotation –

	Yes
29. Legumes, grasses or cereals cut for hay?	29 ☐
30. Legumes, grasses or cereals cut for green feed or silage?	30 ☐
31. Other fodder crops – pumpkin, sunflower, cabbage, sugarcane for feed, etc.?	31 ☐

(Specify) ________________

☐ None *(NO for 29 through 31)*

FIELD SEEDS

Were any of the following field seed crops harvested –

	Yes
32. Alfalfa seed?	32 ☐
33. Other field seed crops – lespedeza, orchardgrass, white clover, etc.?	33 ☐

(Specify) ________________

☐ None *(NO for 32 and 33)*

Exhibit III-2-3. 1971 CENSUS OF AGRICULTURE QUESTIONNAIRE (NORTHERN TERRITORY), FORM A-1b--Continued

Section II – TEMPORARY CROPS HARVESTED THIS YEAR, 1971--Continued

VEGETABLES AND MELONS FOR HOME USE

34. Were any vegetables or melons grown mainly for **USE OF THE HOUSEHOLDS ON THIS HOLDING** – including vegetables and melons from kitchen or home gardens? .... 34 ☐ Yes

☐ None *(NO for 34)*

VEGETABLES AND MELONS FOR SALE

Were any of the following vegetables or melons grown mainly for **SALE FOR HUMAN CONSUMPTION** –

	Yes
35. Cabbage?	35 ☐
36. Watermelons?	36 ☐
37. Cantaloupes and other melons?	37 ☐
38. Tomatoes?	38 ☐
39. Beans–harvested green?	39 ☐
40. Peas–harvested green?	40 ☐
41. Maize or sweetcorn–harvested green?	41 ☐
43. Other vegetables mainly for sale?	43 ☐

(Specify) ____________________

☐ None *(NO for 35 through 43)*

FLOWERS, BULBS, PLANTS

44. Were any flowers, flower bulbs, corms, or ornamental plants grown for sale, seed, or industrial use? .... 44 ☐ Yes

(Specify general class) ____________________

☐ None *(NO for 44)*

OTHER TEMPORARY CROPS

45. Were any other temporary crops harvested – that is, crops generally planted each year or grown in rotation? .... 45 ☐ Yes

(Specify) ____________________

☐ None *(NO for 45)*

Section III – PERMANENT CROPS

This next section concerns permanent (or perennial) crops, trees, vines and berries on this holding this year, 1971. Report for this holding only.

CITRUS FRUITS

Were there any of the following citrus fruit trees on this holding –

	Yes
46. Orange–all varieties?	46 ☐
47. Lemon?	47 ☐
48. Other citrus fruit trees–lime, tangerine, grapefruit, etc.?	48 ☐

(Specify) ____________________

☐ None *(NO for 46 through 48)*

OTHER CULTIVATED TREES, PLANTS, VINES

Were there any of the following other cultivated fruit or nut trees, plants, or vines on this holding –

	Yes
49. Peach–including nectarine?	49 ☐
50. Fig?	50 ☐
51. Banana?	51 ☐
52. Plaintain?	52 ☐
53. Pineapple?	53 ☐
54. Almond?	54 ☐
55. English walnut?	55 ☐
56. Grape?	56 ☐
57. Other cultivated fruit or nut trees, plants, or vines–apple, pear, plum, cherry, papaya, etc.?	57 ☐

(Specify) ____________________

☐ None *(NO for 49 through 57)*

CROPS FOR INDUSTRIAL USE

Were any of the following permanent (perennial) crops grown mainly for **INDUSTRIAL USE** –

	Yes
58. Coffee?	58 ☐
59. Cocoa?	59 ☐
60. Tea?	60 ☐
61. Coconut?	61 ☐
62. Olive?	62 ☐
63. Sisal?	63 ☐
64. Rubber?	64 ☐
65. Other permanent (perennial) crops mainly for industrial use–oil palm, jute, mulberry, etc.?	65 ☐

(Specify) ____________________

☐ None *(NO for 58 through 65)*

Section III – PERMANENT CROPS--Continued

CULTIVATED SMALL FRUITS AND BERRIES

66. Were any cultivated strawberries, raspberries, blueberries, or other small fruits or berries grown on this holding? .... 66 ☐ Yes

(Specify) ____________________

☐ None *(NO for 66)*

PERMANENT GRASSES

67. Were any permanent grasses cut for hay (hay cut from permanent grassland even if pastured or grazed before or after the hay was cut)? .... 67 ☐ Yes

☐ None *(NO for 67)*

NURSERY TREES, VINES, BUSHES

68. Was there a nursery of fruit, nut or other trees, bushes, or permanent (perennial) ornamentals on this holding? .... 68 ☐ Yes

☐ None *(NO for 68)*

OTHER PERMANENT CROPS

69. Were any other permanent (perennial) crops grown on this holding? .... 69 ☐ Yes

(Specify) ____________________

☐ None *(NO for 69)*

Section IV – PRODUCTION FOR SPECIFIC CROPS

(Refer to items 6, 7, 8, 24, 58, and 63 to determine whether the following crops were grown this year.)

3

a. What was the total production of [wheat] [rice] [cotton] [coffee] [sisal] this year, 1971? If any crop was shared, report total–not just your share.
(Report rice production in rough, cotton production in "lint and seed.")

b. How many coffee trees were in compact and scattered plantings last year?

	Yes	a. Quantity	Unit *(Mark "X" or specify other)* Metric tons	Quintals	Kilograms	Other *(Specify)*	b.
70. Wheat	☐	/10	1	2	3		
71. Rice	☐	/10	1	2	3		
72. Cotton	☐	/10	1	2	3		
73. Coffee	☐	/10	1	2	3		
74. Sisal	☐	/10	1	2	3		

☐ None *(NO for 70 through 74)*

Section V – INTERPLANTED AND SUCCESSION CROPS, THIS YEAR, 1971

This next section refers to all temporary and permanent crops you grew this year, 1971.

INTERPLANTED CROPS

75. Were any of the crops interplanted (intercropped) this year – that is grown on the same land at the same time?

1 ☐ Yes 2 ☐ No

SUCCESSION CROPS

76. Were any of the crops harvested in succession on the same land this year?

1 ☐ Yes 2 ☐ No

Section VI – IRRIGATION AND FERTILIZATION, THIS YEAR, 1971

This next section also refers to all temporary and permanent crops you grew this year, 1971.

77. Were any of the crops irrigated this year? Irrigation refers to supplying land with water other than rainfall. When water is collected and brought to the land later, consider this as irrigation. Also, include purposeful flooding of land by rivers, streams, or dams.

1 ☐ Yes 2 ☐ No *(Skip to 78)*

a. Which crops were irrigated?

____________________ ____________________

____________________ ____________________

78. Were any chemical or other commercial fertilizers applied to any cropland this year? Include rock phosphate but do not include lime or gypsum. Also, do not include farmyard manure or crop residue.

1 ☐ Yes 2 ☐ No *(Skip to Section VII)*

a. Which crops were fertilized?

____________________ ____________________

____________________ ____________________

Exhibit III-2-3. 1971 CENSUS OF AGRICULTURE QUESTIONNAIRE (NORTHERN TERRITORY), FORM A-1b--Continued

Section VII – LIVESTOCK AND POULTRY

This next section concerns livestock and poultry. Report all livestock and poultry on this holding, whether owned by you, by your landlord, or by someone else. Include livestock kept on communal or public grazing land if owned [by you] [jointly by your tribe or clan] [by your employer]. If livestock is associated with more than one holding, report animals that are kept on this holding during the night.

ANIMALS ON HOLDING

4

Are there any of the following animals now on this holding or on communal grazing land –	Yes	a. How many?
79. Horses – all ages?	☐	
80. Mules – all ages?	☐	
81. Asses – all ages?	☐	
82. Cattle and calves, including oxen – all ages?	☐	
(Total of (1) and (2) should equal 82) (1) Cows and heifers that have calved?		
(2) All other cattle?		
83. Sheep and lambs – all ages?	☐	
(Total of (1) and (2) should equal 83) (1) Under 1 year old?		
(2) 1 year or older?		
84. Goats and kids – all ages?	☐	
(Total of (1) and (2) should equal 84) (1) Under 1 year old?		
(2) 1 year or older?		
85. Hogs and pigs – all ages?	☐	
(Total of (1) and (2) should equal 85) (1) Under 6 months old?		
(2) 6 months or older?		

5

86. Other domestic animals or animals in captivity now on this holding – camels, buffaloes, llamas, rabbits, etc. – all ages?	☐	
(Specify) ____________		

☐ None *(NO for 79 through 86. If NONE, skip to 93.)*

ANIMALS MILKED

Were any of the following animals milked yesterday –	Yes	a. How many?
87. Cows (cattle)?	☐	
88. Goats?	☐	
89. Other animals – sheep, camels, buffaloes, etc.?	☐	
(Specify) ____________		

☐ None *(NO for 87 through 89)*

ANIMALS FOR TRANSPORT OR DRAFT PURPOSES

Were any of the following animals now on this holding used for transport or draft purposes at any time this year – that is, for carrying loads, pulling or drawing loads, plowing, threshing, grinding, lifting water, etc. –	Yes	a. How many?
90. Cattle, including oxen?	☐	
91. Buffaloes?	☐	
92. Other animals – camels, elephants, llamas, etc.?	☐	
(Specify) ____________		

☐ None *(NO for 90 through 92)*

POULTRY ON HOLDING

Are any of the following kinds of poultry now on this holding –	Yes	a. How many?
93. Chickens – all ages?	☐	
(Total of (1) and (2) should equal 93) (1) Baby chicks and other chickens under 4 months old?		
(2) All chickens 4 months or older?		
94. Other poultry – turkeys, ducks, geese, etc. – all ages?	☐	
(Specify) ____________		

☐ None *(NO for 93 and 94)*

Section VIII – SALE OF AGRICULTURAL PRODUCTS

This next section refers to the sale of agricultural products of this holding during 1971. Agricultural products include crops, livestock, livestock products, poultry, poultry products, forest products, fish, etc.

95. Did the total cash received during 1971 from the sale of agricultural products of this holding amount to –

6

1 ☐ $100 or more?
2 ☐ $25 to $99?
3 ☐ Less than $25? *(Skip to Section IX)*

a. Did half or more of the cash received from the sale of agricultural products come from the sale of –

(1) Crops? 1 ☐ Yes *(Skip to Section IX)* 2 ☐ No

(2) Livestock and poultry – including livestock products and poultry products? 1 ☐ Yes *(Skip to Section IX)* 2 ☐ No

(3) Other agricultural products? 1 ☐ Yes 2 ☐ No *(Skip to Section IX)*

b. What were the other agricultural products?

____________ ____________

____________ ____________

Section IX – AGRICULTURAL POWER, EQUIPMENT, AND TRANSPORT FACILITIES

These next questions are about power, equipment, and transport facilities.

96. This year, was there electric current for use –	Yes	No
a. In the dwelling?	1 ☐	2 ☐
b. Elsewhere on the holding?	1 ☐	2 ☐

97. Was the agricultural work in the fields or elsewhere on this holding done –	Yes	No
a. In part by animal power?	1 ☐	2 ☐
b. In part by mechanical power – that is, by machines propelled or operated by petrol, oil, gas, steam, water, wind, electricity?	1 ☐	2 ☐

(If NO in both 97a and 97b, skip to 99)

98. This year, was any of the following equipment used for agricultural work on this holding –	Yes	No
a. Animal-drawn plows?	1 ☐	2 ☐
b. Tractor-operated plows?	1 ☐	2 ☐
c. Tractors?	1 ☐	2 ☐
d. Threshers (engine-operated)?	1 ☐	2 ☐

99. How many of the following vehicles are now kept on this holding –	None	Number
a. Jeeps, station wagons, motor trucks?	☐	
b. Automobiles?	☐	
c. Animal-drawn carts or wagons?	☐	

Section X – CHARACTERISTICS OF HOLDER'S HOUSEHOLD

100. These next questions relate to the people who live in your housing unit. What are the names, relationship, and ages of all the persons who live in your housing unit? Include infants, hired workers, and other persons who usually live with you. *(List holder on the first line.)*

Line No.	a. Name	b. Relationship to holder	c. Sex *(M or F)*	d. Age as of last birthday
1		HOLDER		
2				
3				
4				
5				
6				
7				
8				
9				
10				
11				
12				

FOR OFFICE USE	Total persons	15 or over		
		Total	Male	Female

Exhibit III-2-3. 1971 CENSUS OF AGRICULTURE QUESTIONNAIRE (NORTHERN TERRITORY), FORM A-1b--Continued

Section XI – MEASUREMENT OF CROP AREA

101. Area measurement sample

1 ☐ Holding in sample for area measurement *(circled A-1b number in column 14 or 15 of A-2b Listing Book)*

2 ☐ Holding not in sample for area measurement *(A-1b number NOT circled in column 14 or 15 of A-2b Listing Book. Skip to Section XII.)*

LAND AREA IN CROPS

(Refer to Sections II and III and determine whether any of the following crops were grown this year, 1971.)

	Yes	No	FOR OFFICE USE Area
102. Wheat	☐	☐	
103. Rice	☐	☐	
104. Cotton	☐	☐	
105. Coffee	☐	☐	
106. Sisal	☐	☐	
107. Other crops	☐	☐	
		TOTAL→	
		Number of separate plots	

(If NO for 102 through 107, skip to Section XII)

Section XII – ENUMERATOR'S RECORD

RECORD OF VISITS

Visit	Date	Notes
First		
Second		
Third		
Fourth		

Principal respondent

Name ______

1 ☐ Holder ☐ Other *(Specify)* ______

2 ☐ Wife

☐ Noninterview *(Explain)* ______

Date completed	Enumerator's signature

Now, I want you to show me all the land on which you grew crops this year. We will start with the field or tract which is closest to here and measure all separate fields or tracts on which crops were grown. We will also measure the specific area(s) on which [wheat] [rice] [cotton] [coffee] [sisal] was (were) grown. *(Make sketch below; then go to Section XII.)*

SCALE: 1 side of each small square equals 20 meters

SPECIAL CASES

Respondent definitely knows how much land was in each crop and has 10 or more hectares of cropland.

Unit of measure ☐ Hectare ☐ Tanbo ☐ Manzana ☐ Other *(Specify)* ______

Tract, field, or plot No.	Wheat	Rice	Cotton	Coffee	Sisal	Other crops	TOTAL
	/10	/10	/10	/10	/10	/10	/10
	/10	/10	/10	/10	/10	/10	/10
	/10	/10	/10	/10	/10	/10	/10
	/10	/10	/10	/10	/10	/10	/10
	/10	/10	/10	/10	/10	/10	/10
TOTAL	/10	/10	/10	/10	/10	/10	/10

(Verify with respondent that this was the approximate total of land in crops. If not, review figures and correct accordingly. Go to Section XII.)

NOTES

Exhibit VI-2-4. PSU CONTROL RECORD FOR MAP PREPARATION, FORM A-271

SHEET______ OF ______ SHEETS

Form A-271 (AGROSTAN) **(June 1970)** MINISTRY OF ECONOMY NATIONAL STATISTICAL OFFICE **PSU CONTROL RECORD FOR MAP PREPARATION** **1971 CENSUS OF AGRICULTURE**	**A.** Province or zone	Code		**B.** District		Code
	C. PSU numbers From ______ to ______			**D.** Date request sent to Geography Division		
	E. Map transmittal	PSU maps *(3 sets)*		District maps *(8 copies)*		
		Initials	Date	Initials	Date	
	☐ Sent by Geography Division ☐ Received in Agriculture Division					

Line No. (1)	Subdistrict No. (2)	EA No. (3)	PSU No. (4)	PSU map prepared *(Date)* (5)	Comments (6)
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					
11					
12					
13					
14					
15					
16					
17					
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26					
27					
28					
29					
30					

BUFF – Geography Division
WHITE – Agriculture Sampling
BLUE – Central Control

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